Coping with climate variability

- Scaling up of resilient practices and technologies

Prasad YG, Singh A K, Prasad JV, Madhuri Thinnaluri, Malathi B, Akila N, Srinivasulu S, Dhanalakshmi G, Chinnam Naidu D, Hemantha Kumar J, Bhargavi K, Mallikarjuna Rao N, Narasimha Reddy S, Yadagiri Reddy T, Sudhakar M, Sudhakar PS, Kavitha, Ramesh R, Ramasubramanian M, Satya VK, Sangeetha S, Siva Jyothi V, Vijayabinandana B, Savitha B, Senthil M and Randhir Singh

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PREFACE

The changes in climate are clearly perceptible over years and are posing challenges to food production and the livelihoods of small and marginal farmers. There is an increase in the frequency of extreme events and the impact there of on food production systems which creates an urgent need to address this issue on priority. Making the farmers increasingly adaptive to climate variability and building resilience of the farming communities is important to face extreme weather events, such as droughts, floods, cyclones etc., which are likely to increase in frequency and intensity in the years to come due to climate change.

The Technology Demonstration Component (TDC) of NICRA aims at addressing the climatic variability in the most vulnerable regions of the country by demonstrating proven, location specific technologies in a representative climatically vulnerable village in a participatory mode. Technologies developed by the national agriculture research system are being demonstrated in farmers' fields so that farmers can observe, assess these technologies and adopt them resulting in minimizing the adverse impacts of climatic variability and in enhancing their adaptive capacity. These resilient technologies, will in turn, be mainstreamed in to the development programs for achieving climate resilient agriculture in the country.

Technology Demonstration Component (TDC) under the NICRA (National Innovations in Climate Resilient Agriculture) project is in operation in 11 climatically vulnerable districts in the states of Andhra Pradesh, Telangana and Tamil Nadu (Zone-X). Location specific best bet innovative practices to address major climatic vulnerabilities such as drought, flood, heat stress and other extreme weather events were demonstrated during 2018-19 in participatory mode in farmers' fields in representative village clusters. Technology interventions in natural resource management, crop production, livestock and fisheries production systems were assessed for imparting resilience to climate vulnerabilities faced by the farmers in the adopted villages. Capacity building programmes and extension activities were also taken up in NICRA villages for brining awareness among farmers on climate smart practices for encouraging wider adoption and spread.

During 2018-19, the NICRA centers located in Chittoor and Srikakulam districts of Andhra Pradesh and Namakkal and Villupuram districts in Tamil Nadu received excess rainfall in the range of 7.50-79.27% compared to annual rainfall. The centers located in Ananthapur, Kurnool and West Godavari (Andhra Pradesh), Khammam and Nalgonda (Telangana) and

Ramanathapuram and Thiruvarur (Tamil Nadu) districts received deficit rainfall (-4.22 to -62.53%). Continuous wet spells were observed at Chittoor, Srikakulam, West Godavari, Khammam, Nalgonda, Thiruvarur and Villupuram. Longest dry spells of 80 days was observed in Khammam followed by Ananthapur (74 days) and Nalgonda (68 days). *In-situ* soil moisture conservation practices and *ex-situ* rainwater harvesting and recharging of wells for supplemental micro irrigation enhanced resilience with higher productivity in pomegranate, paddy, groundnut, tomato, cotton, maize, sweet orange, jowar, jasmine, redgram, citrus, lilly and fodder grass. Tank silt application, soil test based fertilizer application, Vermi-compost application and green manuring enhanced soil quality, water holding capacity and fertility.

Drought tolerant and short duration varieties in rainfed crops such as groundnut, pigeonpea, bengal gram, millets and flood tolerant varieties of paddy in West Godavari gave stable yields. Intercropping systems of millets with pulses and cotton with pulses gave higher returns over sole crops under deficit rainfall conditions. IPM practices in cotton, tomato, paddy and onion crops reduced cost of crop protection and increased profitability.

Improved breeds, fodder, feed and shelter management practices in livestock, poultry, captive rearing of fish seed enhanced productivity and resilience. Capacity development and skill trainings in climate smart agricultural practices and technologies were imparted to 4673 farmers, farm women, youth and extension personnel. Extension activities were taken up in all the districts for awareness and wider adoption of climate resilient agricultural practices covering 13612 farmers.

This publication documents scaling up of climate resilient practices and technologies in predominantly rainfed districts in the three states of Andhra Pradesh, Telangana and Tamil Nadu. We gratefully acknowledge the guidance and constant support received from Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR; Dr. K. Alagusundaram, DDG (NRM); Dr. S. Bhaskar, ADG (AAF&CC); members of the High Level Monitoring Committee (HLMC) and Director, ICAR-CRIDA and PI & Co-PI, NICRA. We appreciate the valuable contributions of farmers and KVK project scientists for contributing to the practice of climate resilient agriculture in this zone.

Authors

CONTENTS

Executive Summary

National Innovations in Climate Resilient Agriculture (NICRA) is a multi-institutional and multi-disciplinary network project launched by ICAR in 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstrations. Technology Demonstration Component is the lifeline of NICRA and was implemented through Krishi Vigyan Kendras (KVKs) during 2018-19 in 11 climatically vulnerable districts located in the states of Andhra Pradesh, Telangana and Tamil Nadu under ATARI, Hyderabad. These include KVKs of Anantapur, Chittoor, Kurnool, Srikakulam and West Godavari in Andhra Pradesh (5 KVKs). Khammam and Nalgonda in Telangana (2 KVKs) and Namakkal, Ramanathapuram, Thiruvarur and Villupuram in Tamil Nadu (4 KVKs).

ICAR-Agricultural Technology Application Research Institute (ATARI), formerly known as Zonal Project Directorate (ZPD), located at Hyderabad is the zonal level coordination unit vested with the responsibility of planning, monitoring and reporting the impact of climate smart interventions carried out by NICRA KVKs in 11 districts across the semi-arid tropics in Zone X.

Under the project, the KVKs implemented Natural Resource Management (NRM), crop production, livestock and fisheries, institutional interventions, capacity building and extension activities with the involvement of 1903, 3422, 1735, 439, 4673 and 13612 farmers respectively. Under the project demonstrations were organized covering an area of 1074.4 ha under NRM and 2792.6 ha under crop production modules.

Rainfall Pattern

The NICRA centers located in Chittoor (53.84 mm) and Srikakulam (222.6 mm) districts of Andhra Pradesh and Namakkal (325.00 mm) and Villupuram (437.92 mm) districts in Tamil Nadu received excess rainfall compared to the respective annual rainfall. The centers located in Anantapur (360.4 mm), Kurnool (299.9 mm) and West Godavari (48.95 mm) (Andhra Pradesh), Khammam (144.11 mm) and Nalgonda (124.90 mm) (Telangana) and Ramanathapuram (163.2 mm) and Thiruvarur (153.2 mm) (Tamil Nadu) districts received deficit rainfall during 2018. Continuous wet spells were observed at Chittoor, Srikakulam, West Godavari, Khammam, Nalgonda, Thiruvarur and Villupuram.

Natural Resource Management

Under natural resource management interventions, renovation of checkdams in Ananthapur district facilitated cultivation of paddy, groundnut, jasmine, castor, lilly, pumpkins, curry leaves and tomato crops as a result of water recharge in the borewells located in the vicinity. Desilting of Burra kunta in Kurnool district resulted in increased water levels (120 ft) in the borewells located in the vicinity. Desilting of village tank in Khammam district, increased the area under cultivation and yield of Paddy.

Conservation of rainwater was achieved through *in-situ* moisture conservation technologies like conservation furrows in redgram (Kurnool) and groundnut (Ananthapur), plastic mulching in tomato (Chittoor), ridges and furrows in cotton (Khammam & Nalgonda), compartmental bunding in groundnut (Namakkal) and dead furrow and broad bed furrow in red gram (Nalgonda) resulted in increased yield, net returns and finally BC ratio compared to local practices. Supplemental irrigation at NICRA villages of Khammam (Cotton, paddy and fodder grass) enhanced the yield due to provision of irrigation at critical stages of crop growth. Green manuring in paddy (Thiruvarur), recycling of domestic field waste through vermicompost at Ramanathapuram in chilli & paddy and tank silt application in cotton (Nalgonda) helped in improving the soil physical and chemical properties besides considerable increment in the crop yields.

Crop Production

In NICRA village of Srikakulam, MTU-1061 (Flood resistant variety) performed best followed by RGL- 2537 and MTU-1075 at low to medium inundation areas. In West Godavari improved variety MTU 1140 (Submergence & lodging tolerant variety) showed higher yield followed by MTU-1061 (Submergence & lodging tolerant variety) in flood prone area. In Thiruvarur, Swarna Sub 1 performed best (high BC ratio) followed by CR 1009 SUB 1. Improved varieties Harithandra (Groundnut) and NJ-2446 (Jowar) at Anantapur, Arka Samrat (Tomato) & Dharani (Groundnut) at Chittoor, PRG-176 (Pigeon pea), NBeG-3 (Bengal gram), NJ-2446 & NJ-2647 (Jowar) at Kurnool, MTU 1156 and MTU 1121 (Paddy) at West Godavari, Siddi- WGL -44 (Paddy) and MGG- 351 (greengram) at Khammam, LRG-52 (redgram) & WGG-42 (Green gram) at Nalgonda, TCGS-1078 (groundnut), VBN-6 (black gram), CO-8 (greengram) & Co(On)5 (small onion) at Namakkal, CO (R) 51&

NLR 34449 (Paddy) and Samba chilli cv. K1 (Chilli) at Ramanathapuram, ADT 5 (black gram) at Thiruvarur and VBN-6 (blackgram) at Villupuram, gave stable yields despite exposure to climate risks.

Among cropping systems, intercropping systems of Mango+Field bean and Tomato + pole bean at Chittoor, Foxtail millet + redgram (5:1) at Kurnool, Cotton + redgram at Khammam, Nalgonda and Srikakulam performed better than sole crops. Under delayed sowings, short duration variety of foxtail millet (SIA 3088) proved to be a better alternative and was profitable than desi cotton at Kurnool under rainfed situation. Crop diversification with Amaranthus and ragi at Villupuram, Castor at Ananthapur, and Sesamum at Srikakulam was found remunerative compared to traditional crops. Improved seed drill sowing in Bengal gram & Jowar at Kurnool not only saved the cost of labour but also reduced the cost of cultivation and increased area of operation over traditional practices.

Water saving technologies viz., zero tillage in maize at Srikakulam, direct seeding with drum seeder in Paddy at Chittoor and West Godavari, micro irrigation in onion and groundnut at Namakkal, SRI cultivation in paddy at Thiruvarur and Pani pipe technology in Paddy at Villupuram not only improved the water use efficiency but also productivity and profitability of the crops.

Nutrient management practices *viz.,* spraying of micronutrient mixture in mango at Chittoor, use of liquid bio fertilizers in paddy at West Godavari, foliar nutrient application in cotton at Nalgonda and biofertilizer application in paddy at Ramanathapuram gave higher economic benefits than corresponding farmers practices.

IPM practices in paddy (Srikakulam, West Godavari, Thiruvarur and Villupuram), tomato at Chittoor, onion at Namakkal and cotton at Kurnool were found as profitable crop protection measures.

Livestock and Fisheries

In livestock based interventions, improved fodder varieties Hybrid Napier Co-4 and CoFS-31 at Chittoor, APBN-1 at Nalgonda and at COFS-29, COBN-5, GG-3 and Stylosanthes at Villupuram recorded higher fodder yields.

Silage making intervention made available the green, nutritious fodder during off season and registered higher milk productivity than farmers practice in dairy animals at NICRA villages of Kurnool, Namakkal and Villupuram. Feed enrichment through *Azolla* enhanced the milk productivity and fat content of milk at Khammam. Supplementation of protein and energy through mineral block increased the milk yield at NICRA villages of Kurnool, Khammam, Villupuram and Ramanathapuram. Improved poultry breeds viz., Rajasree (Chittore, Kurnool, West Godavari & Nalgonda), Namakkal Desi at Ramanathapuram, TANUVAS Aseel at Thiruvarur and Nandanam-2 at Villupuram were found superior to desi breeds in terms of bird weight, number of eggs and net income. Calf registration at Kurnool district of Andhra Pradesh increased body weight of calves and decreased mortality rate. Captive rearing of fish from fry stage to fingerling stage in nursery pond, reduced the investment on fingerling cost and increased survival rate at Srikakulam district of Andhra Pradesh.

Capacity Building

Need based training programmes (156) were organized with participation of 4673 farmers by NICRA KVKs in Zone-X. In Andhra Pradesh 103 training programmes were organized with the participation of 3031 farmers. In Telangana, 22 training programmes were organized with participation of 633 farmers. In Tamil Nadu, 31 training programmes were conducted with active participation of 1009 farmers. The training programmes included natural resource management, resource conservation technologies, cropping systems, crop diversification, integrated pest and disease management, soil health improvement, water saving technologies, farm implements and machinery, livestock management etc.

Extension Activities

Extension activities (317) were organized across the zone with active participation of 13612 farmers. Among these 188 activities were conducted with the participation of 10281 farmers in Andhra Pradesh. About 1782 farmers participated in 69 extension activities in Telangana State. About 60 extension activities were conducted with the involvement of 1549 farmers in Tamil Nadu.

कार्यकारी सारांश

राष्ट्रीय जलवायु समुत्थान कृषि मे नवप्रवर्तन (निक्रा) वर्ष 2011 मे भाकृअनुप द्वारा आरंभ की गई एक बहु-संस्थागत एवं बहु-विषयक नेटवर्क परियोजना है। इस परियोजना का उद्देश्य अनुकूल अनुसंधान एवं प्रौद्योगिकी के प्रदर्शनों द्वारा जलवायु परिवर्तन एवं जलवायु विविधता से भारतीय कृषि के समुत्थान को बढ़ावा देना है। प्रौद्योगिकी प्रदर्शन अवयव निक्रा जीवनाधार है एवं इसे कृषि तकनीकी एवं अनुप्रयोग संस्थान (अटारी), हैदराबाद द्वारा आंध्रप्रदेश, तेलंगाना एवं तमिलनाडु के राज्यों में स्थित 11 जलवायुवीय रूप से अतिसंवेदनशील जिलों में वर्ष 2018-19 के दौरान कृषि विज्ञान केंद्रों द्वारा कार्यान्वित किया गया। इसमें आंध्रप्रदेश (5 कृषि विज्ञान केंद्र) में स्थित अनंतपुर, चित्तूर, कर्नूल एवं श्रीकाकुलम; तेलंगाना (2 कृषि विज्ञान केंद्र) में स्थित खम्मम एवं नलगोंडा; तमिलनाडु (4 कृषि विज्ञान केंद्र) में स्थित नमक्कल, रामानाथापुरम, तिरूवरूर एवं विल्लापुरम के कृषि विज्ञान केंद्र शामिल हैं।

हैदराबाद में स्थित भाकृअनुप- कृषि तकनीकी एवं अनुप्रयोग संस्थान (अटारी), जो पहले क्षेत्रीय परियोजना निदेशालय कहलाता था। इसे क्षेत्र x के 11 जिलों में फैले अर्ध-शुष्क उष्णकटिबंधीय क्षेत्रों में निक्रा कृषि विज्ञान केंद्रों द्वारा योजना, मॉनिटरी एवं चलाए जा रहे जलवायु अनुकूल हस्तक्षेपों के प्रभाव की रिपोर्टिंग की जिम्मेदारी सहित क्षेत्र स्तरीय समन्वयन का कार्य भी सौंपा गया है।

परियोजना के अंतर्गत, कृषि विज्ञान केंद्रों ने क्रमश: 1903, 3422, 1735, 439, 4673 एवं 13612 किसानों के सहयोग से प्राकृतिक संसाधन प्रबंधन, फसल उत्पादन, पशु पालन एवं मछली पालन, संस्थागत हस्तक्षेप, क्षमता निर्माण एवं प्रसार गतिविधियों को कार्यान्वित किया। परियोजना के अंतर्गत प्राकृतिक संसाधन प्रबंधन के अंतर्गत 937.24 हेक्टेयर क्षेत्र एवं फसल उत्पादन नमूनों के अंतर्गत 1074.4 हेक्टेयर क्षेत्र में प्रदर्शनों का आयोजन किया गया।

वर्षा पैटर्न

संबंधित वर्षा की तुलना में आंध्र प्रदेश के चित्तूर (53.84 मि.मी) एवं श्रीकाकुलम (222.6 मि.मी) जिलों में; तमिलनाडु के नमक्कल (325 मि.मी), एवं विल्लुपूरम (437.92 मि.मी) जिलों में स्थित निक्रा केंद्रों में अतिरिक्त वर्षा हुई। वर्ष 2018 के दौरान आंध्र प्रदेश के अनंतपुर (360.4 मि.मी), कुरनूल (299.9 मि.मी) एवं पश्चिम गोदावरी (48.95 मि.मी); तेलंगाना के खम्मम (360.4 मि.मी) एवं नलगोंडा (24.90 मि.मी); एवं तमिलनाडु के रामानाथपुरम (163.20 मि.मी) जिलों में स्थित केंद्रों में कम वर्षा प्राप्त हुई। चित्तूर, श्रीकाकुलम, पश्चिम गोदावरी, खम्मम, नलगोंडा, तिरूवरूर एवं विल्लुपूरम में लगातार नम दौर देखा गया।

प्राकृतिक संसाधन प्रबंधन

प्राकृतिक संसाधन प्रबंधन हस्तक्षेपों के अंतर्गत, चित्तूर जिले के अंत:स्रवण तालाबों (चिन्नकोत्तचेरूवु, करनमवारीचेरूवु एवं गुट्टयानाचेरूवु) नवीकरण से समीपवर्ती बोरवेलों में जल के रीचार्ज के परिणामस्वरूप धान, टमाटर, मूंगफली एवं चारा फसलों की खेती संभव हो सकी। कर्नूल जिले के बुर्रकुंटा में गाद निकालने से समीपवर्ती क्षेत्रों में स्थित बोरवेलों के जल स्तर (120 फीट) में वृद्धि हुई। श्रीकाकुलम जिले के अंत:स्रवण तालाब (जगन्नथ नायुडु तालाब) के नवीकरण से धान की खेती का विस्तार एवं उत्पादन में वृद्धि हुई।

अरहर (कर्नूल एवं नलगोंडा) तथा कपास (नलगोंडा) में संरक्षण कूंड; मूंगफली (अनंतपुर) में अवभूमि गहरी जुताई; टमाटर (चित्तूर) में प्लास्टिक पलवार; कपास (खम्मम) में मेंढ एवं कूंड; मूंगफली, मूंग एवं उडद (नमक्कल) में उपखंडीय मेंढ एवं आम (चित्तूर) में खाई व मेंढ जैसे स्व-स्थाने नमी संरक्षण प्रौद्योगिकियों द्वारा वर्षा जल का संरक्षण किया गया। जिससे स्थानीय प्रक्रियाओं की तुलना में अधिक उत्पादन, कुल लाभ एवं बीसी अनुपात प्राप्त किया गया। फसल उगाऊ के क्रांतिक स्तरों पर सिंचाई के प्रावधान के कारण खम्मम (कपास,धान एवं चारा), चित्तूर (मूंगफली) एवं रामानाथपुरम (धान) के निक्रा गांवों में अतिरिक्त सिंचाई देने से पैदावार में बढोत्तरी हुई। आम (चित्तूर), प्याज (नामाक्कल) एवं धान (नलगोंडा) में हरी खाद एवं वर्मीकंपोस्ट द्वारा घरेलु खेत की अवशिष्टों के पुन:चक्रण से खम्मम में मृदा भौतिकी एवं रासायनिक गुणों में सुधार के अलावा फसलों के उत्पादन में यथेष्ट वृद्धि हुई।

फसल उत्पादन

श्रीकाकुलम के निक्रा के गांवों में, एमटीयू-1061 (बाढ प्रतिरोधी किस्म) ने श्रेष्ठ निष्पादन दिया इसके बाद कम से मध्यम बाढ़ग्रस्त क्षेत्रों के लिए आरजीएल-2537 एवं एमटीयू-1140 अच्छे पाए गए। पश्चिम गोदावारी में उन्नत किस्म एमटीयू 1061 (जलमग्नता एवं अवशयन सहीष्णु किस्म) ने अधिक उत्पादन दिया। इसके बाद बाढ़ग्रस्त क्षेत्र में एमटीयू-1061 (जलमग्नता एवं अवशयन सहीष्णु किस्म) का स्थान था। तिरूवरूर में, स्वर्ण एसयूबी 1 (लंबी अवधि) ने श्रेष्ठ (अधिक बीसी अनुपात) निष्पादन दिया । इसके बाद सीआर एसयूबी 1009 का स्थान था। अनंतपुर में उन्न्त किस्म हरितांध्र (मूंगफली); चित्तूर में अरका साम्राठ (टमाटर) एवं धरणी (मूंगफली); कर्नूल में पीआरजी-176 (अरहर), एनबीईजी-3 (चना), एनजे-2446 एवं एनजे-2647 (ज्वार); पश्चिम गोदावरी में एमटीयू 1156 एवं एमटीयू 1121 (धान); खम्मम में सिध्धी –डब्ल्यूजीएल44 (धान) एवं MGG-351 (मूंग); नलगोंडा में एलआरजी -52 (अरहर) एवं VBN-6 (उड़द); नामाक्कल में Co-8 (उड़द) एवं Co-5 (छोटा प्याज); रामनाथापुरम मे ADT-5 (मूंग) 51; विल्लापुरम में वीबीएन-6 (उड़द) ने जलवायु जोखिमों के बावजूद स्थिर उत्पादन दिया।

सस्ययन प्रणालियों में, एकल फसल की तुलना में, चित्तूर मे आम+ग्वार एवं टमाटर+ पोल बीन; कर्नूल में कंगनी+अरहर (5:1); खम्मम में कपास (सरपंच)+अरहर (डब्ल्यूआरजी-65); नलगोंडा और श्रीकाकुलम में कपास+अरहर (6:1) के अंतरा सस्ययन प्रणालियों ने बेहतर निष्पादन दिया। देर से बोई गई फसलों के अंतर्गत, कर्नूल के वर्षा आधारित फसलों के अंतर्गत कंगनी (एसआईए 3085) का लघु अवधि किस्म एक बेहतर विकल्प सिद्ध हुआ एवं देसी कपास की तुलना में लाभदायक था। अनंतापुर के विल्लुपुरम में अमरनाथ और रागी, अनंतापुर में रेंड़ी अमरनाथ और रागी, श्रीकाकुलम में सेसमम पारंपरिक फसलों की तुलना में लाभदायक पाया गया था। कुरनूल में चने और ज्वार में बेहतर बीज ड्रिल से बुवाई ने न केवल श्रम की लागत को बचाया बल्कि खेती की लागत को कम किया और पारंपरिक प्रथाओं पर परिचालन का क्षेत्र बढ़ाया।

जल बचत प्रौद्योगिकियां जैसे कि श्रीकाकुलम के मक्का के खेतों में शून्य कर्षण, चित्तूर एवं पश्चिम गोदावरी में ड्रम सीडर से धान की सीधी बोवाई, तिरूवरूर की धान की खेतों में एसआरआई कृषि एवं विल्लुपुरम के धान की खेती में पानी पाईप की प्रौद्योगिकी को अपनाने से न केवल जल उपयोग क्षमता में सुधार हुआ बल्कि फसलों की उत्पादकता एवं लाभों में भी वृद्धि हुई।

पोषक प्रबंधन प्रक्रियाएं जैसे कि नलगोंडा के कपास में मृदा जांच आधारित उर्वरकों का प्रयोग, चित्तूर के टमाटर में उर्वरक एवं सिंचाई की समय सूची, चित्तूर के आम एवं नलगोंडा के कपास में सूक्ष्म पोषक मिश्रण का छिडकाव एवं पश्चिम गोदावरी के धान में द्रव जैव-उर्वरकों के उपयोग ने संबंधित किसानों की प्रक्रियाओं की तुलना में आर्थिक रूप से अधिक लाभदायक सिद्ध हुआ।

खम्म्म के कपास में कीटनाशकों का पर्ण छिडकाव की तुलना में तना पर प्रयोग, श्रीकाकुलम एवं पश्चिम गोदावारी जिलों के धान में, नामक्कल के प्याज एवं चित्तूर के टमाटर में समेकित नाशीजीव प्रबंधन प्रक्रियाएं लाभदायक फसल संरक्षण प्रक्रियाएं सिद्ध हुई।

पशु एवं मछली पालन

पशु पालन आधारित हस्तक्षेपों में, चित्तूर में संकर नैपियर, सीओ-4 एवं सीओएफएस-31; विल्लुपुरम में सीओएफएस-29, सीओबीएन-5 एवं जीजी-3; नलगोंडा के एपीबीएन-1 उन्नत चारा किस्मों से अधिक चारा उत्पादन दर्ज किया गया।

ऑफ सीजन के दौरान सीलेज निर्माण हस्तक्षेपों से हरा, पोषक चारा उपलब्ध कराया गया एवं नमक्कल एवं विल्लुपुरम के निक्रा के गांवों में किसानों द्वारा डेरी पशुओं को दिए जाने वाले दाना की तुलना में अधिक दूध का उत्पादन दर्ज किया गया। चित्तूर में ओजोल्ला द्वारा चारा संवर्धन से दूध का उत्पादन एवं दूध मे वसा की मात्रा

में वृद्धि हुई। कर्नूल, खम्मम, विल्लुपुरम एवं रामनाथापुरम के निक्रा गांवों में खनिजों से प्रोटीन एवं ऊर्जा की अतिरिक्त मात्रा पशुओं को मिलने से दूध की मात्रा में वृद्धि हुई। उन्नत पोल्ट्री नस्लों जैसे कि राजश्री (चित्तूर, कर्नूल, खम्मम एवं नलगोंडा), पश्चिम गोदावरी में वनराज, ग्रामप्रिया एवं श्रीनिधितथा विल्लुपुरम में नंदनंम-2 पक्षी भार, अंडों की संख्या एवं कुल लाभ के मामले में देसी नस्लों की तुलना में उन्नत पाए गए। आंध्र प्रदेश के कर्नूल जिला के बछड़ा पंजीकरण से बछड़ों के शारीरिक भार में वृद्धि एवं मृत्यु दर में कमी आई। आंध्र प्रदेश के श्रीकाकुलम के नर्सरी तालाबों में पोना स्तर से आंगुलिक स्तर तक मछलियों का संरक्षण पालन से आंगुलिका लागत पर होने वाले निवेश में कमी आई एवं इससे मछलियों की उत्तरजीविता दर में वृद्धि हुई।

क्षमता निर्माण

क्षेत्र-x के निक्रा कृषि विज्ञान केंद्रों द्वारा 4673 किसानों की भागीदारी से आवश्यकता आधारित प्रशिक्षण कार्यक्रमों (156) का आयोजन किया गया। आंध्र प्रदेश में 3031 किसानों की भागीदारी से 103 प्रशिक्षण कार्यक्रमों का आयोजन किया गया। तेलंगाना में, 633 किसानों की भागीदारी से 22 प्रशिक्षण कार्यक्रमों का आयोजन किया गया। तमिलनाडु में, 1009 किसानों की सक्रियभागीदारी से 31 प्रशिक्षण कार्यक्रमों का आयोजन किया गया। इन प्रशिक्षण कार्यक्रमों में प्राकृतिक संसाधन प्रबंधन, संसाधन संरक्षण प्रौद्योगिकियां, सस्ययन प्रणालियां, फसल विविधिकरण, समेकित नाशीजीव एवं रोग प्रबंधन, मृदा स्वास्थ्य सुधार, जल बचत प्रौद्योगिकियां, कृषि उपकरण एवं यंत्र, पशुधन प्रबंधन आदि शामिल किए गए।

प्रसार गतिविधियां

13612 किसानों के सक्रिय भागीदारी से संपूर्ण क्षेत्र में प्रसार गतिविधियां (317) आयोजित की गई। इनमें से आंध्र प्रदेश में 10281 किसानों की भागीदारी से 188 गतिविधियां आयोजित की गई। तेलंगाना राज्य में 69 प्रसार गतिविधियां आयोजित की गई, जिसमें करीब 1782 किसानों ने भाग लिया। तमिलनाडु में 1549 किसानों की भागीदारी से करीब 60 प्रसार गतिविधियां आयोजित की गई।

1. Introduction

Climate is the primary determinant of agricultural productivity which directly impacts food production across the globe. Agricultural sector is the most sensitive sector to climate change because the climate of a region/country determines the nature and characteristics of vegetation and crops. Food security is both directly and indirectly linked with climate change. Any alteration in the climatic parameters such as temperature, humidity and rainfall which govern crop growth will have a direct impact on quantity of food produced. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest and ultimately affecting the food security of the country. Indian agriculture too faces such challenges which have become all the more daunting due to extreme weather situations like droughts and incessant rains, frequency of which has been on a raise. The major impacts of climate change will be mainly on rainfed or un-irrigated crops, which are cultivated on nearly 60 percent of crop land. Farmers dependent on rainfed agriculture, being less endowed in terms of financial, physical, human and social capital have limited capacity to adapt to the changing climate. Delayed onset of monsoon, mid-season and terminal droughts and incessant rains occurring in a short period in rainfed areas are causing huge losses to agriculture and livestock production.

Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. By incorporating various adaptation measures in agricultural systems, one can increase the resilience and adaptive capacity of the small land holders. To sustain the productivity of crops and allied enterprises in the context of increasing climatic vulnerabilities, climate resilient technologies that would increase production and productivity need to be evolved, assessed and demonstrated. Keeping this in view, National Innovations in Climate Resilient Agriculture (NICRA) was contemplated as a network project of Indian Council of Agricultural Research (ICAR) and was launched in February, 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration. The project consists of four components *viz.,* Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants.

Technology Demonstration under NICRA

In order to deal with climatic change under technology demonstration component of NICRA, extensive demonstrations of location-specific best bet practices contributing to climate resilience were organized in 11 districts in Andhra Pradesh, Telangana and Tamil Nadu. The project is implemented in these districts by respective Krishi Vigyan Kendra (KVK) located in the district.

Objectives:

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies
- To demonstrate site specific technology packages on farmers fields for adapting to current climate risks
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application.

Under this component, an integrated package of proven technologies would be demonstrated in one village panchayat in each district with an aim to mitigate the adverse effects of climate variability in crop and livestock production systems.

Process of Project Implementation

As a part of the process each KVK has developed action plans by adopting following steps:

1. Formation of inter-disciplinary team consisting of specialists from plant breeding, Natural Resource Management (NRM), Agronomy, Horticulture, Plant protection, livestock, Fisheries, Agricultural Economics, Extension and Home Science etc., The inter-disciplinary team formed in each KVK gives input in selection of an appropriate village, identification of climatic vulnerabilities with regard to agriculture and finalization of climate resilient technology package. The composition of the team varied depending upon the type of climatic vulnerability faced in selected village.
2. The target village was selected based on degree of vulnerability in the district by using secondary/published data like prolonged drought, dry-spells, extreme rainfall events, hailstorms, extreme temperatures, cold and heat waves, frost and flood etc.,
3. The village selected for the project activities represents the dominant cropping system of the district. The proportion of the rainfed area in the chosen village was supposed

to be more than district average. A higher portion of small and marginal farmers were considered for inclusion in the project. It was made sure that majority of the farmers in selected village derived major portion of income from agriculture and allied activities. The climatic vulnerability of the village (Intensity of droughts, floods, heat wave, cold wave etc.) represented that of the district.

4. Climatic characteristics of selected village in terms of quantum and distribution of rainfall, number of rainy days, intensity of rain-spells, number of dry spells over the last 10 years, length of growing season, number of floods that severely damage crops and livestock and other extreme events like frost, heat, cold waves, hail storms, sea inundation of agricultural fields was documented.

5. Participatory Rural Appraisal (PRA) in selected villages was organized to understand major farming systems, resource situation, socio-economic, institutional and infrastructural status.

6. The multidisciplinary team in each KVK analysed the constraints related to climatic variability and identified the points of intervention focusing largely on resource poor groups addressing resource conservation which gives long term and sustainable benefits. The modules that were implemented in selected villages focused on building resilience in soil, adapted cultivars and cropping systems to climatic variability, rainwater harvesting and recycling, water saving technologies, community managed custom hiring centers, crop contingency plans, livestock and fishery interventions and institutional interventions for community ownership of the programme.

The technological interventions were implemented in participatory mode. The team in each KVK documented the impact of modules with measurable indicators. The progress of the project activities in all NICRA villages was monitored by ATARI, Hyderabad and a Zonal monitoring team constituted by ICAR-CRIDA. As per the 'way forward' suggested by the High Level Project Committee of NICRA at the end of 12th Plan, the emphasis of TDC-NICRA was shifted to spread of promising resilient technologies to nearby villages though formation of NICRA village clusters, saturation of the adopted villages with at least one NRM, crop production and livestock technology, enhancing access to water, recycling of biomass and improving productivity of resources. This was supposed to be achieved through forging greater convergence with other government agencies operating in the district towards similar goal.

The interventions at each NICRA center cover the following four modules:

Module I: Natural Resource Management

This module consists of interventions related to *in-situ* moisture conservation, water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, artificial ground water recharge and water saving irrigation methods and interventions related to soil quality and fertility management.

Module II: Crop Production

This module consists of introducing drought/temperature tolerant varieties, biotic stress tolerant varieties, advancement of planting dates of *rabi* crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, community nurseries for delayed monsoon, location specific intercropping systems with high sustainable yield index and crop diversification with crops that withstand climatic variability.

Module III: Livestock and Fisheries

This module consists of introduction of improved breeds of livestock, poultry, and fisheries, use of community lands for fodder production during droughts/ floods with improved breeds of fodder, improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water, etc.

Module IV: Institutional Interventions

This module consists of institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring center, collective marketing and introduction of weather index based insurance and climate literacy through a village level weather station. The village institutions are managed through VCRMC which meets at regular intervals and takes decisions related to management of community resources, interventions to be taken up based on prevailing weather and management of CHC, seed and fodder banks.

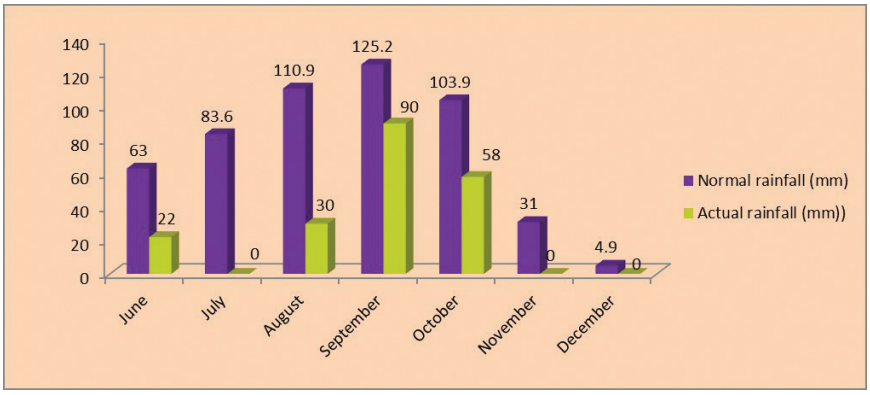
2. Basic resources and rainfall analysis of NICRA villages

Andhra Pradesh

Anantapur

Anantapur is the second most drought-affected district of India. It falls under scarce rainfall zone of Andhra Pradesh. It is in the arid agro-ecological zone and is marked by dry summers and mild winters The NICRA programme is implemented in three clusters of villages namely Chamaluru belonging to Narpala mandal; Chakrayapeta, Peravali**,** Bandameda palli and Sivapuramu under Singanamala mandal. The major climatic and soil constraints of the villages are low and erratic rainfall, uneven distribution of rainfall, delayed monsoon, early cessation of monsoon, prolonged dry spells, shallow depth of soils, low water holding capacity, saline and alkali soils. The mean annual rainfall of the district is 576.4 mm and actual rainfall during 2018 was 216 mm in 11 rainy days which is -62.53% (-360.4 mm) deviation from normal (Table 2). The predominant crops grown in this villages are groundnut, castor, pigeonpea, maize, paddy, tomato and brinjal. Total cultivable land under these villages is 4060 ha where 80% of area (3239 ha) is under rainfed cultivation. Land preparation was taken up during the 1st and 2nd FN of June month with receipt of rains (22 mm) during the first and second week of June (Table 3). Sowings of groundnut were done by some farmers during June month but majority of groundnut was sown during second week of August. Groundnut, the major crop of this region experienced severe moisture stress during the months of July (-100% deviation) and August (-72.9% deviation) due to scanty rainfall situation. Ground nut crop was adversely affected during peg initiation, maturity and pod filling stages, hence the crop was a total failure during kharif 2018. A total of 6 dry spells (> 10-20 days) were observed without any continuous wet spells (>100 mm) (Table 5). Cropping season *i.e.,* from June to December received very low rainfall compared to normal where 100 % deviation was observed during July, November and December. The deviation during June, August, September and October was -65.08%, -72.9%, -28.1% and -44.18% respectively (Table 3).

Distribution of rainfall during crop season at Anantapur during 2018

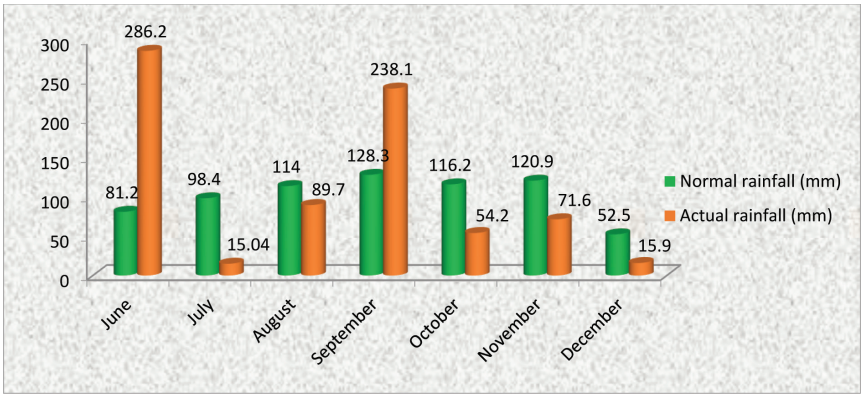


Chittoor

The villages selected for implementing NICRA activities are Chittecherla and Deendarlapalli belonging to Chinnagottigallu mandal. The major climatic vulnerability of the village is drought. The normal annual rainfall of the village is 717.7 mm and the actual rainfall during 2018 was 771.5 mm which was 7.5% higher than normal (Table 2). Agriculture in this area is mainly rainfed and main sources of irrigation are tanks and bore wells. The major soil types are red loamy soils and red sandy soils. The main crops in the selected village are paddy, groundnut, tomato, pigeon pea, mango and vegetables. Excess rainfall of 252.0% and 85.6% were received during the months of June and September respectively and deficit rainfall of 84.7% and 21.3% was received during July and August during SW monsoon (Table 3). Two prolonged dry spells i.e., 4th July - 4th August (32 days) and 16th - 27th August (12 days) and two continuous wet spells *viz.,* 3rd - 4th June (161.8 mm) and 15th - 20th September (242 mm) were observed during Kharif season (Table 5). In response to mid season drought, KVK has demonstrated life saving irrigation with sprinkler, rain gun and conservative furrows in groundnut and foliar application of 2% Urea and 0.5% Zinc sulphate using power sprayers to overcome stress in groundnut and mango during dry spell.

With the receipt of excess rains during the month of September, 2018, the incidence of tikka leaf spot in groundnut and bacterial leaf spot disease in tomato crop was severe at the end of kharif Season. Accordingly control measures were suggested in respective crops. During NE monsoon season, the village received 141.7 mm rainfall as against normal rainfall of 289.6 mm. There was 51.0% deficit rainfall during this rabi season .

Distribution of rainfall during crop season at Chittoor during 2018

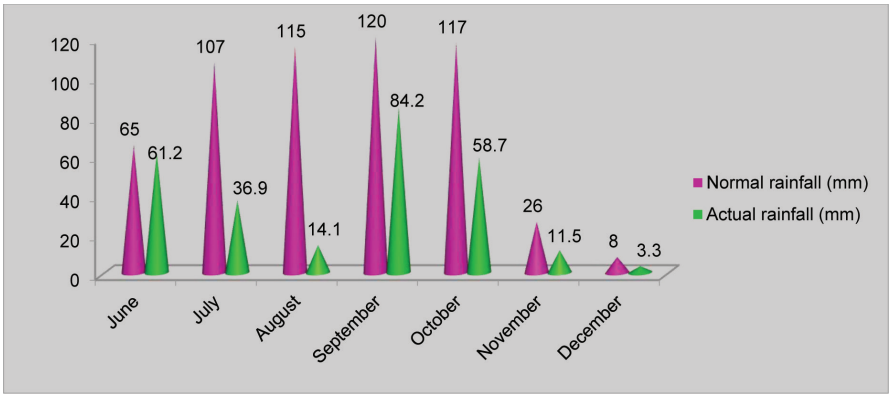


Kurnool

Kurnool is one of the drought prone districts of Andhra Pradesh. Yagantipalle, Meerapuram, Cherlokottur and Krishnagiri villages belonging to Banaganapalle mandal with 70% of rainfed agriculture are selected for implementing NICRA project. The major soil types are black soils. Desi cotton, foxtail millet and pigeonpea are the main crops grown during kharif and sorghum, sunflower and chickpea in rabi. The major source of irrigation is bore wells. Most of the crops are affected by late onset of monsoon followed by dry spells during critical crop growth periods, which in turn is severely affecting the yield of these crops. Water scarcity, poor soil health, frequent droughts and losses due to pest and diseases are major climatic vulnerabilities faced by the farming community. The actual rainfall received during 2018 was 333.1 mm against normal rainfall of 633 mm which is -47.38% deviation (Table 2). Kharif sowings were taken up with the rain fall received during 1st & 2nd week of June and rabi sowings during 3rd week of October-2018. A total of 7 prolonged dry spells were observed during crop season without any continuous wet spells (Table 5). In case of foxtail millet, pest incidence was very low but crop suffered from dry spells in July, August and September, which drastically affected the yields (1-2.5 q/ac). In Bt. Cotton, due to increased temperatures in July and August, incidence of sucking pests (aphids (5%), white flies (6-8/ leaf) and jassids (5-6/leaf)) were observed in October and November which led to square drop.

Foxtail millet affected by dry spells during July-September

Distribution of rainfall during crop season of at Kurnool, 2018



Srikakulam

Srikakulam is one of the flood prone districts in Andhra Pradesh. Heavy floods occur generally during September and occasionally in October and November due to heavy rain fall and depressions formed in Bay of Bengal. The villages selected for implementing NICRA project activities are Sirusuwada and Vera Narayana Puram belonging to Kothuru mandal, Kondavalasa belonging to Sarubujjili mandal and Ponnam belonging to srikakulam

mandal. The major cropping systems in this village include paddy/ cotton/ vegetables/ pulses/ groundnut. Mid seasonal drought is most frequent due to erratic distribution of rainfall. The villages are prone to floods due to excess rainfall received during monsoon season in low lying areas of around 180 ha lying near Jagannatha Naidu tank either due to overflow of hill stream in Marripadu Gedda or water from Vamsadhara river. Major sources of irrigation include Vamsadhara canal, wells, ponds, Baljivanigedda Aayakattu and borewells. The normal annual rainfall is 1195 mm but actual rainfall was 1417.6 mm which was 222.6 mm excess received during 2018 (Table 2). The rainfall received during the month of May facilitated to take up land preparation in kharif season, 2018. In anticipation of onset of monsoon during first week of June, sowings were taken up during second fortnight of June by broadcasting paddy. Good germination of paddy was noticed upon receipt of 122 mm rainfall in the 2nd fortnight of June. Severe flash flood occurred due to heavy rain on 15th, August 2018 (41.2 mm excess rainfall) which affected the paddy crop at tillering stage**,** resulting in tearing of leaf tips (Table 3). An excess rainfall of 35.8 mm was received during the month of September (142.0) against normal of 106.2 mm which was congenial for the incidence of blast and sheath blight in paddy. Titli cyclone occurred during 11th& 12th October (34.8 mm excess rainfall) at panicle initiation stage of paddy and silt deposition on leaves and crop lodging was observed. Pethai cyclone occurred during 17th&18th December (60.2 mm excess rainfall) which coincided with harvesting of paddy. The KVK Suggested to spray 5% salt solution to avoid pre germination of the grains. However grain discoloration was noticed and seed production plots were severely affected. Real time contingency measures were demonstrated in Titli and Pethai cyclone affected paddy and cotton crops. A total of 5 dry spells and 4 continuous wet spells were observed during crop season of 2018 (Table 5).

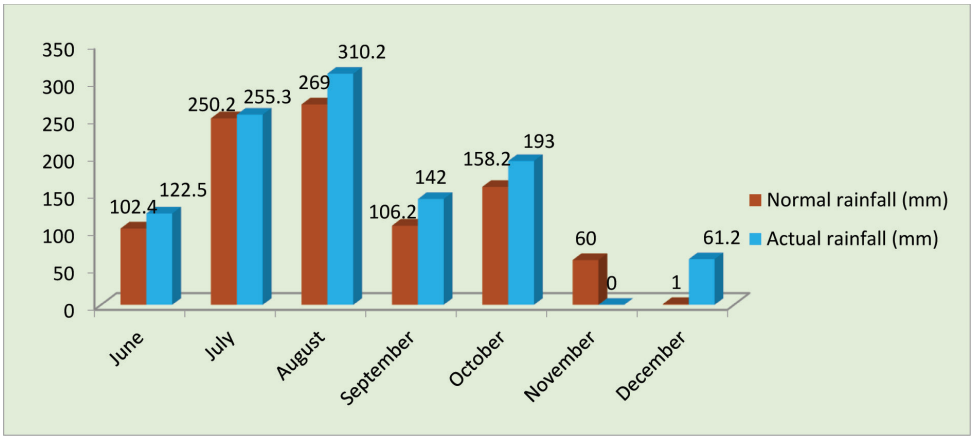
Complete inundation of paddy fields during titli

Silt deposition on paddy post cyclones

Effect of Pethai Cyclone on paddy

Cyclone affected cotton

Distribution of rainfall during crop season at Srikakulam during 2018

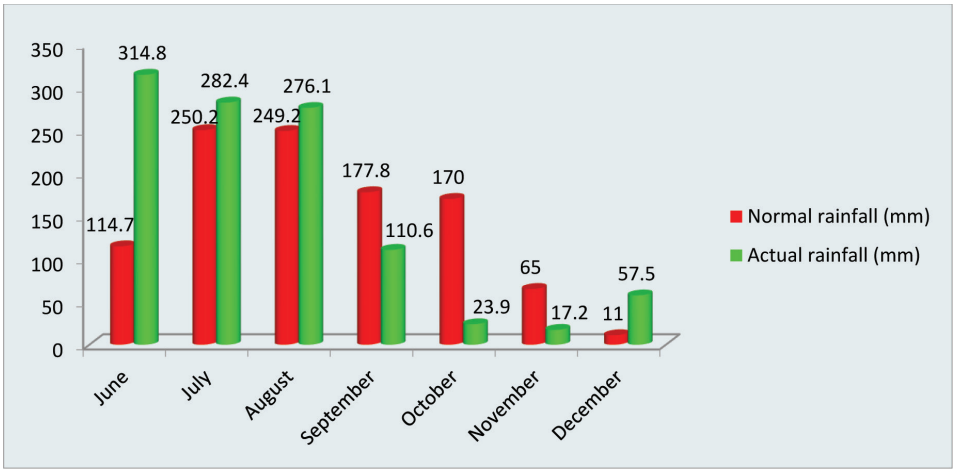


West Godavari

Floods and cyclones are the major climatic constraints in the Godavari districts of Andhra Pradesh. Rice is the major crop in this district and most of the crop gets damaged by heavy rains during August and September months. Matsyapuri, Kamsali Bethpudi and Koparru villages were selected to implement the activities of NICRA. The major soil types are alluvial soils. The major existing cropping systems are paddy-paddy-pulses. Water logging, mid season drought, poor soil health are major limitations to the crop productivity whereas mortality and morbidity during the post flood, loss of fish during floods and fodder scarcity are major constraints for livestock in this villages. The actual rainfall received during 2018 was 1110.59 mm over annual mean rainfall 1159.54 mm which is -4.22% deviation (Table 2). In the month of June, rainfall received was 314.8 mm which was distributed over

12 rainy days and gave a good boost to the growth of crops during kharif. Due to sufficient rainfall and timely release of water through canals, most of the farmers prepared paddy nurseries by 1st FN of June. During the months of July (12.87%) and August (10.79%), excess rainfall was received and distributed in 18 and 22 days respectively (Table 3). The evenly distributed rain fall helped in timely transplanting of paddy. During the months of September, October and November there was a deficit rainfall of -37.8%, -85.94% and -73.53% respectively (Table 3). Due to availability of sufficient canal water the crops were not affected. Moreover this year, there is no high rainfall, cyclone and any other climate related vagaries in the NICRA adopted Villages. 5 prolonged dry spells and 2 continuous wet spells were observed during cropping season of 2018 (Table 5).

Distribution of rainfall during crop season at West Godavari during 2018



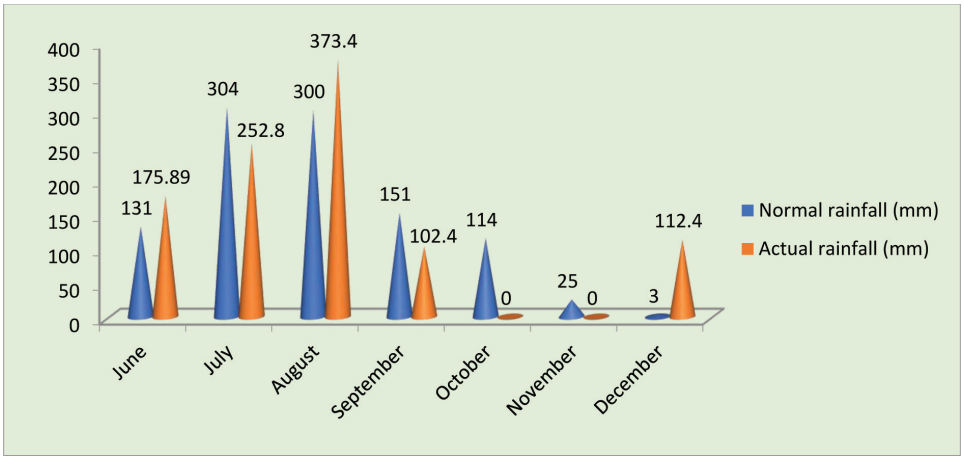
Telangana

Khammam

Khammam district is situated in Northern Telangana. The village of Nacharam (Nacharam and Cluster villages; Gangulanacharam, colony nacharam, Ramatanda, Bhadrutanda, Muniyatanda and Bheemlatanda) situated in Enkoor mandal of Khammam district is selected for implementing the NICRA activities. Seasonal drought and heat waves are the major climatic vulnerability of this cluster. Paddy, cotton, chillies and sugarcane are the major crops grown in the project village. Total cultivable area in these NICRA villages is 1382 ha and 89% of the area (1230 ha) is under rainfed cultivation. The major soil types are black and red soils. Major sources of irrigation include streams and bore wells. The village

receives an annual rainfall of 1161 mm with uneven distribution. During 2018, the actual rainfall was 1016.89 mm which was -12.41% (144.11 mm deficient rainfall) less than normal rainfall (Table 2). Excess rainfall was received during the months of June (34.27%), August (24.47%) and December (3646.7%) and deficient in the months of July (16.84%), September (32.2 %), October (100%) and November (100%) (Table 3). A total of 3 prolonged dry spells and 4 continuous wet spells were observed during crop season of 2018 (Table 5).

Distribution of rainfall during crop season at Khammam during 2018

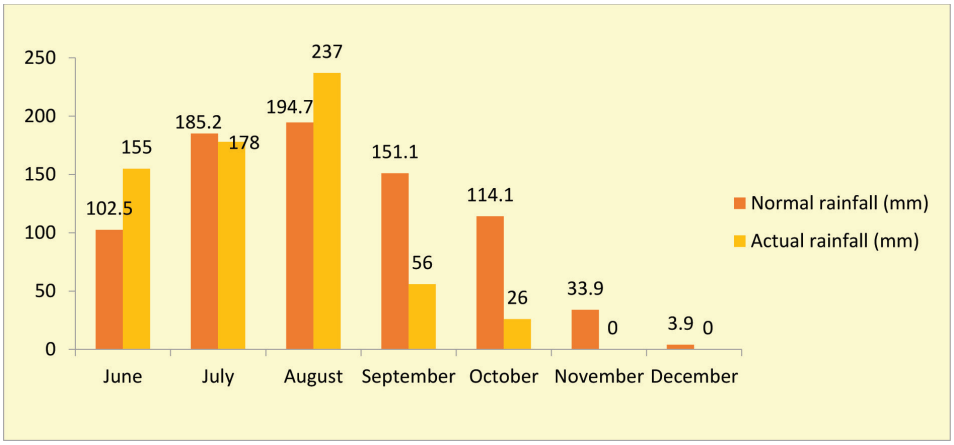


Nalgonda

Nalgonda district falls under Southern Telangana region. The villages Nandyalagudem, Boring Thanda and Kothathanda of Atmakoor(S) mandal are selected for implementing NICRA project activities. About 70.8 % of cultivable area (334 ha) of the village is under rainfed cultivation. Light black to medium black soils are the major soil types in NICRA villages. The major crops grown in these villages are cotton, pigeon pea, green gram, paddy, mulberry and vegetables. The major climatic vulnerability is drought (intermittent dry-spells) and heat waves. Most of the crops get affected with late onset of monsoons followed by mid and terminal dry spells during critical crop growth periods which in turn severely affects the yield. Wells and bore wells are major sources of irrigation. The average annual rainfall is 836.9 mm and the distribution is erratic. The actual rainfall received during 2018 was 712 mm which was 124.9 mm deficient compared to normal (Table 2). Excess rainfall

was observed during the months of June (51.22%) and August (21.73%) and deficit in July (3.8%), September (62.9%), October (77.21%), November and December (100% each) (Table 3). A total of 5 dry spells and 2 wet spells were observed during crop season of 2018 (Table 5).

Distribution of rainfall during crop season at Nalgonda during 2018

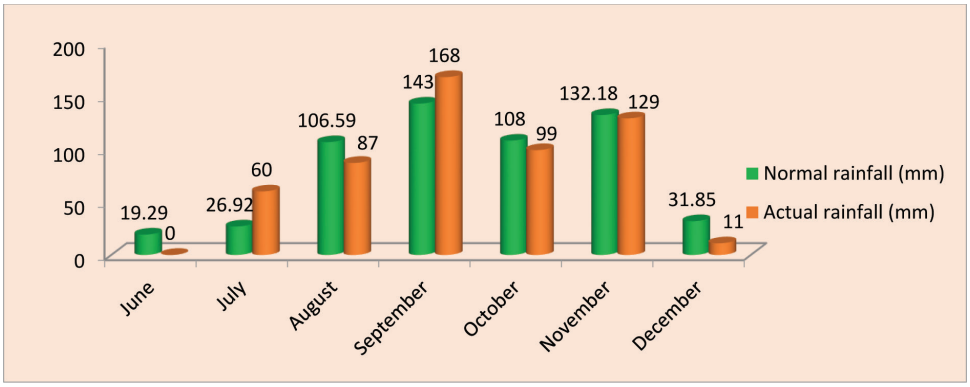


Tamil Nadu

Namakkal

Namakkal district is a drought-prone with annual rainfall of 410 mm. The mean maximum and minimum temperatures are 46 and 12ºC. Vadavathur, Jambumadai and Thipramadevi villages belonging to Earumaipatti mandal were selected to implement the NICRA project. Undulating and slopy lands aggravate the drought condition due to lack of scope for percolation of rainwater in the catchment and water storage areas. This has led to monocropping (October to January) during northeast monsoon. 60% of total cultivated area is under rainfed condition. Sandy clay loam is the major soil type. Small onion, groundnut and sorghum are the main crops grown in this villages. Major sources of irrigation include open wells and borewells. The actual rainfall was 735 mm which was 325 mm (79.27%) excess over the normal during 2018 (Table 2). In the months of July and September excess rainfall of 33.08 mm and 25.5 mm respectively was received and deficient was observed in the months of June, August, October, November and December (Table 3 & 4). No continuous wet spells were observed and a maximum of 7 prolonged dry spells were recorded during the crop season of 2018 (Table 5).

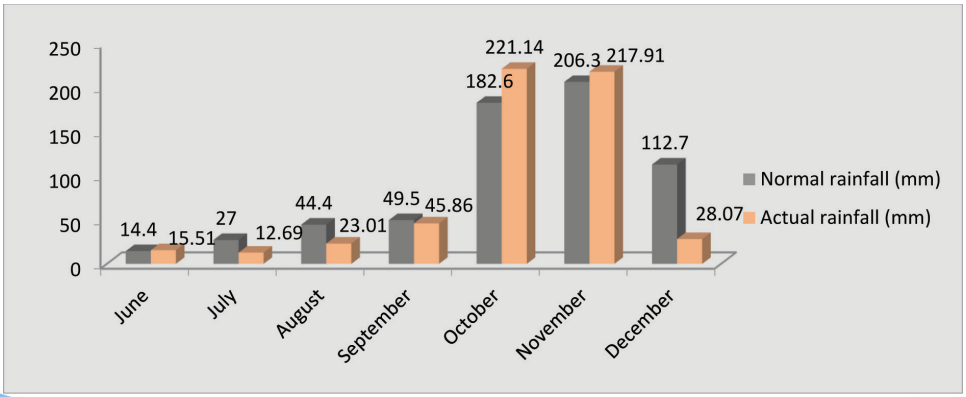
Distribution of rainfall during crop season at Namakkal during 2018



Ramanathapuram

Ramanathapuram district is situated in the southeast corner of Tamil Nadu state and falls in the rain shadow region and there by is a highly drought prone and most backward in development. The NICRA programme is implemented in Kombuthi and Karukathi villages of Ramanathapuram district. Drought is the major climatic challenge in the cluster village. Agriculture in this cluster villages is mainly dependent on the north-east monsoon and the available water in the Kalari tank. It receives an annual rainfall of 827 mm. Among the total cultivated area (302 ha), 81% (245 ha) falls under rainfed condition. The major soil type of the village is sandy clay loam. Paddy and chilli are mainly cultivated in NICRA adopted villages. The actual rainfall during 2018 was 663.8 mm which was 163.2 mm (19.73%) less than the normal (Table 2). Excess rainfall was received during the months of June, October and November in the crop season (Table 3 & 4). Prolonged dry spells (4) were observed without any wet spells (Table 5).

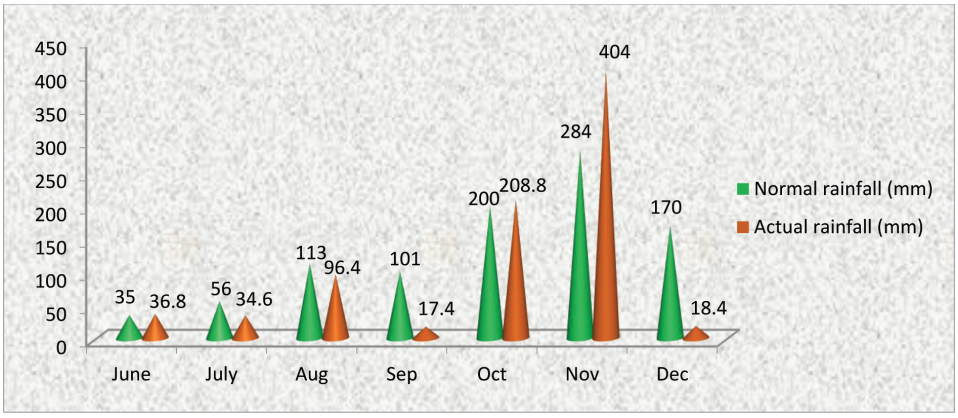
Distribution of rainfall during crop season at Ramanathapuram during 2018



Thiruvarur

NICRA project was implemented in the villages of Rayapuram, Keelapattu and Pullavarayan Kudikadu belonging to Needamangalam mandal of Thiruvarur district. The mean annual rainfall is 1140 mm where floods are the main climatic constraint. Paddy is the main crop cultivated during Samba season (September- January). The main problem encountered in the village during monsoon season (Oct.-Nov.) is submergence of paddy crop due to high intensive rainfall and cyclones during the period. As a result, the farmers in the village lose about 75 per cent of paddy production besides total wastage of paddy straw and livestock is also affected due to floods. Of the total cultivated area (1960 ha), 57% area (1115 ha) is flood prone in NICRA adopted villages. The major sources of irrigation are Kuyavan canal, Nallore canal and Odai canal. Drought may occur during April and May and sometimes it may extend up to July. The actual rainfall received during 2018 was 986.8 mm which is -13.44% lower (153.2 mm deficient rainfall) than normal. (Table 2). Excess rainfall of 8.8 mm and 120 mm was observed in the months of October and November respectively (Table 4). Continuous wet spells were observed along with dry spells (Table 5).

Distribution of rainfall during crop season at Thiruvarur during 2018



Villupuram

Villupuram district is basically agrarian and has bimodal pattern of rainfall. The district is prone to cyclical drought and it is the major climatic vulnerability. Bulk of precipitation is received during North East monsoon and the area suffers from intense heat during summer. The crops raised during *Kharif* and summer face intermittent drought. The villages Kattusivri and Agoor of Mailam Mandal were selected for implementing NICRA project activities. The villages receive an annual rainfall of 824.68 mm. Major soil type is Sandy clay loam.

Paddy, groundnut and sugarcane are the major crops and 50 % of cultivable area (413.77 ha) is under rainfed cultivation in these villages. The actual rainfall received during 2018 was 1262.6 mm which was 437.92 mm (53.10%) excess compared to normal rainfall (Table 2). June, August, September, October and November months received excess rainfall over the normal where 5 continuous wet spells were observed (Table 3, 4 & 5).

Distribution of rainfall during crop season at Villupuram during 2018

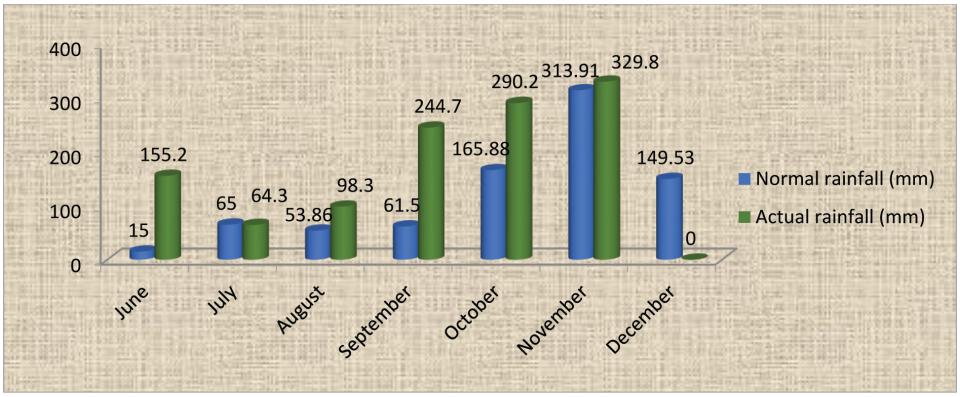


Table 1: Details of various NICRA centers of Zone-X

District	Names of NICRA villages	Annual rainfall (mm) 2018	Soil type	Major climatic vulnerability
Andhra Pradesh				
Ananthapur	Chamalur, Peravali, Chakrayapeta, Bandameda palli and Sivapuramu	216	Red soils	Drought
Chittoor	Chittecherla and Deendarlapalli	771.5	Red soils	Drought
Kurnool	Yagantipalle, Meerapuram, Cherlokottur and Krishnagiri	333.1	Black soils	Drought
Srikakulam	Sirusuwada, Ponnam, Veera Narayana puram and Kondavalasa	1417.6	Red sandy soils	Floods
West Godavari	Mathsyapuri, Kamsali Bethpudi and Koparru	1110.6	Alluvial soils	Floods

District	Names of NICRA villages	Annual rainfall (mm) 2018	Soil type	Major climatic vulnerability
Telangana				
Khammam	Nacharam, Ganagula Nacharam, Muniya thanda, Badru thanda, Colony nacharam, Rama thanda and Bheemla thanda	1016.9	Black and red soils	Drought and heat stress
Nalgonda	Nandyalavari Gudem, Boring Thanda and Kotha thanda	712	Black soils	Drought and heat stress
Tamil Nadu				
Namakkal	Vadavathur, Jambumadai and Thipramadevi	735	Sandy clay loam	Drought
Ramanathapuram	Kombuthi and Karukathi	663.8	Sandy clay loam	Drought
Thiruvarur	Rayapuram, Keelapattu and Pullavarayan kudikadu	986.8	Sandy clay loam	Drought and floods
Villupuram	Kattusiviri and Agoor	1262.6	Sandy clay loam	Drought

Table 2: Rainfall details of NICRA villages in Andhra Pradesh, Telangana and Tamil Nadu

Name of the centre	Normal annual rainfall (mm)	Rainfall during 2018 (mm)	Excess/ deficit rainfall (mm)	% deviation of rainfall from the normal i.e., Actual – Normal × 100 ---------- Normal
Andhra Pradesh				
Anantapur	576.4	216	-360.4	-62.53
Chittoor	717.7	771.54	53.84	7.50
Kurnool	633	333.1	-299.9	-47.38
Srikakulam	1195	1417.6	222.6	18.63
West Godavari	1159.54	1110.59	-48.95	-4.22
Telangana				
Khammam	1161	1016.89	-144.11	-12.41
Nalgonda	836.9	712	-124.9	-14.92
Tamil Nadu				
Namakkal	410	735	325	79.27
Ramanathapuram	827	663.8	-163.2	-19.73
Thiruvarur	1140	986.8	-153.2	-13.44
Villupuram	824.68	1262.6	437.92	53.10

Normal and actual rainfall of NICRA KVKs of Zone-10 during 2018

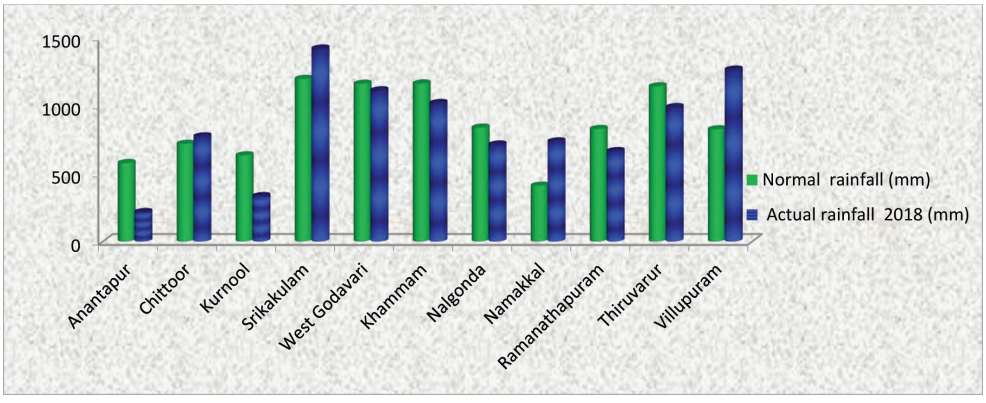


Table 3: Rainfall distribution at different NICRA sites during South West monsoon season during 2018

Centre	June			July			August			Sep			Total		
	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)
Andhra Pradesh															
Anantapur	63.00	22.00	-65.1	83.60	0.00	-100.00	110.90	30.00	-72.95	125.20	90.00	-28.12	382.70	142.00	-62.90
Chittoor	81.20	286.20	252.5	98.40	15.04	-84.72	114.00	89.70	-21.32	128.30	238.10	85.58	421.90	629.04	49.10
Kurnool	65.00	61.20	-5.8	107.00	36.90	-65.51	115.00	14.10	-87.74	120.00	84.20	-29.83	804.60	771.04	-4.17
Srikakaulam	102.40	122.50	19.6	250.20	255.30	2.04	269.00	310.20	15.32	106.20	142.00	33.71	727.80	830.00	14.04
West Godavari	114.70	314.80	174.5	250.20	282.40	12.87	249.20	276.10	10.79	177.80	110.60	-37.80	791.90	983.90	24.25
Telangana															
Khammam	131.00	175.89	34.27	304.00	252.80	-16.84	300.00	373.40	24.47	151.00	102.40	-32.19	886.00	904.49	2.09
Nalgonda	102.50	155.00	51.22	185.20	178.00	-3.89	194.70	237.00	21.73	151.10	56.00	-62.94	633.50	626.00	-1.18
Tamil Nadu															
Namakkal	19.29	0.00	-100.00	26.92	60.00	122.88	106.59	87.00	-18.38	143.00	168.50	17.83	295.80	315.50	6.66
Ramanathapuram	14.40	15.51	7.71	27.00	12.69	-53.00	44.40	23.01	-48.18	49.50	45.86	-7.35	135.30	97.07	-28.26
Thiruvarur	35.00	36.80	5.14	56.00	34.60	-38.21	113.00	96.40	-14.69	101.00	17.40	-82.77	305.00	185.20	-39.28
Villupuram	15.00	155.20	934.67	65.00	64.30	-1.08	53.86	98.30	82.51	61.50	244.70	297.89	195.36	562.50	187.93

Green	Normal Rainfall (-19 to +19%)
Red	Deficit Rainfall (>-19 to <-60%)
Blue	Excess rainfall (+19%)
Yellow	Scanty Rainfall (>-60)

Table 4: Rainfall distribution at Tamil Nadu NICRA sites during North East monsoon season during 2018

Centre	October			November			December			Total		
	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)
Tamil Nadu												
Namakkal	108.00	99.50	-7.87	132.18	129.50	-2.03	31.85	11.00	-65.46	272.03	240.00	-11.77
Ramanathapuram	182.60	221.14	21.11	206.30	217.91	5.63	112.70	28.07	-75.09	501.60	467.12	-6.87
Thiruvarur	200.00	208.80	4.40	284.00	404.00	42.25	170.00	18.40	-89.18	654.00	631.20	-3.49
Villupuram	165.88	290.20	74.95	313.91	329.80	5.06	149.53	0.00	-100.00	629.32	620.00	-1.48

Green	Normal Rainfall (-19 to +19%)
Blue	Excess rainfall (+19%)
Yellow	Scanty Rainfall (>-60)

Table 5: Dry spells and Continuous wet spells observed in NICRA centers during Kharif and Rabi, 2018

Centre	Rainfall during cropping season (mm)	Dry spells (more than 10-20 days)	Continuous wet spells (more than 100 mm)
Andhra Pradesh			
Anantapur	200.00	13th June- 4th August (53 days), 6th- 15th August (10 days), 17th August - 15th September (30 days), 23rd September- 4th October (13 days), 6th October- 16th October (11 days), 19th October- 31st December (74 days)	No wet spells were observed
Chittoor	770.74	4th July -4th August (32 days), 16 -27th August (12 days), 21st September-3rd October (13 days), 20th October- 22nd November (34 days), 6th-31st December (26 days)	3rd-4th June (161.8 mm) and 15- 20th September (242 mm)
Kurnool	269.90	14th -30th June (17 days), 15th July- 9th August (26 days), 16th August -6th September (22 days), 27th September - 16th October (20 days), 20th October- 15th November (27 days), 17th November- 3rd December (17 days),5th-31st December (27 days)	No wet spells were observed
Srikakulam	1084.20	13th-23th June (11 days), 6th -16th September (11 days), 23rd September- 1st October (10 days), 13th October -16th December (65 days), 21st-31st December (11 days)	20th-21st July (125 mm), 14th-16th August (176.6 mm), 17th- 22nd September (119.8 mm), 10th-12th October (180.2 mm)
West Godavari	1082.50	6th-15th October (10 days), 18th October-2nd November (16 days), 7th- 16th November (10 days), 18th November-6th December (19 days), 19th- 31st December (13 days)	27th-28th June (130.1mm),18th-20th August (110.3 mm),

Centre	Rainfall during cropping season (mm)	Dry spells (more than 10-20 days)	Continuous wet spells (more than 100 mm)
Telangana			
Khammam	1016.89	13th-27th June (15 days), 22nd July -1st August (11 days), 28th September- 16th December (80 days),	6th -10th July (118.6mm), 12th-18th July (124.4 mm), 11th-16th August (154.6 mm), 17th-18th December (109.6 mm)
Nalgonda	652.00	12th-21st June (10 days), 21st July- 9th August (20 days), 21st August -9th September (20 days), 20th September -23 rd October (34 days), 25th October-31st December (68 days)	11th-14th July (119 mm), 16th-20th August (170 mm)
Tamil Nadu			
Namakkal	555.50	1st-30th June (30 days), 3rd July- 2nd August (31 days), 4th - 22nd August (19 days), 31st August- 12th September (13 days), 23rd October -2nd November (11 days), 4th -17th November (14 days), 6th-31st December (26 days)	No wet spells were observed
Ramanathapuram	564.19	17th June- 2nd July (16 days), 10th July- 3rd August (25 days), 5th-30th August (26 days), 8th-24th December (17 days)	No wet spells were observed
Thiruvarur	816.40	7-16th June (10 days), 4th July -3rd August (31 days), 5th-23 rd August (19 days), 29th August- 8th September (11 days), 10th- 28th September (19 days), 23rd October- 1st November (10 days), 5th -22nd December (18 days),	3rd-7th October (176.2 mm), 23rd-24th November (155 mm)
Villupuram	1182.50	6th-16th June (11 days), 18th-27th June (10 days), 4th -25th July (22 days), 16th -31st August (16 days), 2nd- 15th September (14 days), 24th November- 31st December (38 days)	17th June (111 mm), 16th-17th September (121.1 mm), 4th -6th October (131.4 mm), 20th-22nd October (134.2 mm), 20th-23rd November (258.1 mm)

3. Natural Resource Management (NRM)

3.1 *Ex-situ* water harvesting and efficient use

This NRM activity is taken up to harvest rain water in existing village tanks, farm ponds, check dams and similar water storage structures which are either renovated/desilted or newly constructed as part of the NICRA project in the adopted village. This water is put to use for various purposes like extending area under irrigation through deployment of efficient methods of irrigation, raising livestock and also production of fish. The enhanced storage of harvested rain water led to rise in the level of water in the open and bore wells in the vicinity which could be utilized for irrigation for an extended period covering more crops.

Anantapur

Desilting and renovation of series of check dams

Desilting and renovation of a series of check dams was taken up during 2018-19 by increasing their dimensions from 41 x 10 x 1.3 m, 75 x 14 x1.0 m and 90 x 32 x 1.5 m to 60 x 40 x 2.5 m, 80 x 21 x 1.8 m and 108 x 53 x 2.5 m respectively. Deepening of check dams created additional water storage capacity and 22 borewells and 6 open wells in the vicinity of the check dam were recharged. Farmers irrigated the fields with the recharged water in the check dam and supplied through sprinkler or drip irrigation at critical crop growth stages and fetched high returns. Different crops grown under check dams were paddy, groundnut, Jasmine, castor, lilly, pumpkins, curry leaves and tomato covering an area of 40.8 ha benefitting 16 farmers

In another NICRA village, three more check dams were desilted increasing their dimensions from 26 x 11 x 0.5 m, 55 x 04 x 0.5 m and 92 x 11 x 0.5 m to78 x 12 x 2.0 m, 60 x 12 x 2.0 m and 100 x 17 x 2.0 m and storage capacity to 18,72,000, 14,40,000 and 34,00,000 l of water, respectively. The crops that could be given supplemental irrigation through drip or sprinkler system are pomegranate, groundnut, maize, sweet orange, jowar, jasmine, redgram, citrus and lilly. The water could also be used for drinking purpose of livestock. A total of 15 borewells and 07 open wells were recharged in the vicinity of check dams benefiting 45 farmers covering an area of 39 ha.


Check dam-1 before and after renovation

Check dam -1 filled with water after receiving rainfall during September


Check dam-2 before and after renovation

Check dam-2 filled with water after rains

Check dam-3 before and after renovation

Check dam-3 filled with water after rains

Chittoor

Renovation of Kamakshammaccheruvu percolation tank

The old irrigation tank, Kamakshammacheruvu located near Thummachenupalli of Chittecherla village was renovated under NRM activity during 2018-19. The unwanted vegetation in the tank was removed and desilting was taken up with the help of JCB. The dimension of the tank was increased from 9,30,600 m^3 to 1200600 m^3 after renovation and the water storage capacity of the tank from 930.6 lakh liters to 1200.6 lakh liters. The ayacut under this tank covers an area of about 64 ha where 38 farmers were benefited and 8 bore wells were recharged. Crops like tomato, groundnut, paddy and fodder crops were cultivated through sprinkler or drip irrigation by harvesting the water from the percolation tank.

Kamakshammaccheruvu before and after renovation

Kurnool

Desilting of Burrakunta

The existing percolation tank (Burrakunta) in the NICRA village was deepened and the silt was applied on marginal soils in the vicinity to improve soil physical properties and fertility. Deepening of percolation tank created additional water storage capacity of 12.60 lakh liters and the number of defunct bore wells also decreased over years from 2013-14 to 2018-19. The recharge of defunct bore wells (52 out of 120) was 20 per cent during the monsoon period and water was available at a depth of 120 feet itself compared to 200.6 feet during summer months (Table 6 & 7). Even during rain free months of November and December, 4-8 acres of crop land per bore well could be given supplemental irrigation because of the recharge of bore well resulting from desilting of the percolation tank.

Burrakunta before desilting

Water storage in Burrakunta

Table 6: Impact of de silting of Burrakunta on bore well recharge during the year 2018-19

Month	Water table in the bore well (ft)	Availability of water in Water storage structure (ft.)	Average area irrigated acre / bore well	Rainfall (mm)
June-18	180	2.0	-	61.2(5)
July-18	180-200	1.5	1.0	36.9 (5)
August-18	175	1.0	1.0	14.1(2)
September-18	120	3.6	2.0	84.2(8)
October-18	165-180	2.5	1-2	58.7(2)
November-18	170-190	2.5	0-1	11.5(1)
December-18	200	2.0	0	03.3(1)

Average of six bore wells taken for data -Total number of bore wells – 40

Table 7: Year wise impact of Burrakunta on borewells recharge

Year	No. of borewells under Burrakunta	No. of defunct borewells during summer	No. of defunct borewells recharged during monsoon period	Depth of water table(ft.) during summer	Depth of water table(ft.) during monsoon period	Average rainfall (mm)
2013-14	110	70 (64%)	64 (91 %)	158.4	71.4	594.3
2014-15	110	63 (57%)	60 (95%)	150.2	74.6	668.6
2015-16	114	26 (23%)	26 (100%)	145.4	106.4	621.6
2016-17	114	72 (63%)	56 (78%)	156.6	96.4	655.5
2017-18	114	0	100%	120.4	64.0	798.0
2018-19	120	52 (45%)	12 (20%)	200.6	120	333.1

Srikakulam

Renovation of Jagannadha Naidu Tank

Renovation of Jagannadha Naidu tank was initiated during the year 2011-12 to improve its storage capacity, repair the weakened sluices and bunds which would prevent water over flow and damage to the crops during heavy rains in tank fed areas. The water collected in the tank was utilized to overcome water scarcity at early and later stages of the crop during kharif. This resulted in higher productivity of paddy and enhanced net returns to the farmers over 80 ha of area.

During 2018-19 the paddy yields were drastically reduced compared to previous years due to Titli and Pethai cyclonic effect. During the Titli cyclone, the crop was at panicle initiation to flowering stage and heavy rains and flash floods resulted in pollen washout and crop lodging which led to decrease in the yields. During the Pethai cyclone, grain discoloration was noticed and as the seed production fields were affected, seed could not be used for next season.

Titli cyclone effect on paddy fields

Pethai cyclone effect in paddy field

Khammam

Desilting of village tank

Desilting of village tank was taken in Nacharam village of Khammam district to increase the area under irrigation and also the ground water levels. The area cultivated under village tank was increased from 12 to 15 ha during Kharif and 6 ha during rabi due to increase in water storage capacity by 34,40,000 lt. farmers cultivated paddy using tank water and the harvested water was also catered to for drinking water needs of livestock in summer season.


Village tank before and after desilting

Paddy cultivated under village tank

Thiruvarur

Desilting of Canal

Naval poondi (Karambai) – Vilvarayan karambai pirivu canal situated at Rayapuram was desilted in order to improve drainage facility and also to avoid water stagnation during flooding or critical stage of crop growth. Around 300 acres of paddy crop will be saved from floods covering 263 farmers.


The drainage canal before and after desilting

3.2 *In-situ* moisture conservation technologies

Andhra Pradesh

Anantapur

Demonstration of conservation furrows at 3.6 m interval in groundnut was taken up with the objective of allowing rain water to be percolated during rains and more moisture to be retained in the soil to support crop growth during dry spells. This intervention was taken up during kharif in an area of 10 ha covering 5 farmers at NICRA village of Anantapur district recorded 20% increase in yield with an additional net returns of Rs.3438/ha over the farmers practice (Table 8).

Conservation furrows in groundnut

Chittoor

Mulching is an effective method of manipulating crop growing environment to increase yield and improve product quality by controlling weed growth, ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content. Demonstrations on plastic mulching in tomato were conducted in an area of 5 ha benefitting 5 farmers resulted in higher yield of 56.65 t/ha whereas farmers practice (no mulching) gave only 48.58 t/ha with an additional net income of Rs.17924/ha. Use of plastic mulching reduced the number of irrigations due to availability of soil moisture for a longer period and also reduced weed growth at critical stages of crop (Table 8).

Plastic mulching in tomato

Kurnool

In-situ moisture conservation measures by formation of conservation furrows between rows of pigeonpea during kharif in an area of 4 ha covering 10 farmers at NICRA village of Kurnool district recorded an additional yield of 202 kg/ha with a favourable B:C ratio of 1.51 over the farmers practice (Table 8).

Conservation furrows in pigeonpea

Khammam

Demonstration of Cotton on ridges and furrows was taken up in 10 ha area covering 5 farmers at Khammam district to allow percolation and retention of moisture for a longer time during crop period. Ridges and furrows in cotton recorded an additional yield of 154 kg/ha with 18% increase in net returns over the farmers practice (Table 8).

Ridges and Furrows in Cotton

Nalgonda

The *in-situ* moisture practice of dead /conservation furrows was demonstrated in cotton and pigeon pea over 28.8 and 8 ha area involving 36 and 10 farmers respectively for moisture conservation and stabilizing or enhancing productivity under rain fed conditions. The crop was under moisture stress during dry spell period of 19 and 20 days that occurred in the months of July and August. It was observed that moisture was retained at a depth of 20 cm in the fields where dead furrows were formed even during dry spells. The fields with conservation furrows recorded 14.54% and 16.02% increase in yield over farmers practice with an additional net income of Rs.10677/ha and Rs.2105/ha respectively (Table 8).

In-situ moisture conservation in cotton through ridge and furrows in an area of 1.2 ha covering 2 farmers was taken up in NICRA village of Nalgonda district. This practice resulted in 15.71% increased yield with higher net returns of Rs.44465/ha over farmers practice with a favourable benefit cost ratio of 1.77. Broad bed furrow method of sowing in pigeon pea in an area of 4 ha covering 4 farmers resulted in improved yield of 170 kg/ha than the farmers practice without BBF (Table 8).

Namakkal

Compartmental bunding in groundnut was demonstrated in an area of 18 ha covering 45 farmers as an *in-situ* moisture conservation measure in the NICRA village. Due to the moisture conserved through this practice, additional yields of 105 kg /ha with 16.25% increase in net returns and benefit cost ratios of 1.92 were realized (Table 8).

Compartmental bunding in groundnut

Table 8: Effect of *in-situ* moisture conservation practices on productivity and profitability of different crops

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Ananthapur	Groundnut	Farmer practice	5	10	361	24760	22689	-2071	--
		Conservation furrows			433	25760	27127	1367	1.0
Chittoor	Tomato	Farmer practice	5	5	48580	83844	153027	69183	1.8
		Plastic mulching			56651	91344	178451	87107	1.9
Kurnool	Pigeonpea	Farmer practice	10	4	316	14680	16748	2068	1.1
		Conservation furrows			518	18135	27454	9319	1. 5
Khammam	Cotton	Farmer practice	5	10	1821	52129	87420	35291	1.7
		Ridge & furrow			1975	53918	94824	41626	1.7
Nalgonda	Cotton	Farmer practice	2	1.2	1750	56285	88805	32520	1.6
		Ridge and Furrows			2025	58310	102775	44465	1.8
	Pigeonpea	Farmer practice	4	4	687	27737	37812	10075	1.4
		Broad bed furrow			857	28650	46887	18237	1.6
	Cotton	Farmer practice	36	28.8	1740	57125	88740	31615	1.5
		Dead furrow			1993	59532	101825	42292	1.7
	Pigeonpea	Farmer practice	10	8	805	30020	44275	17255	1.5
		Dead furrow			934	32010	51370	19360	1.6
Namakkal	Groundnut	Farmer practice	45	18	875	32300	58750	26450	1.8
		Compatmental bunding			980	33250	64000	30750	1.9

3.3. Water harvesting and recycling through supplemental irrigation

Khammam

Supplemental irrigation in cotton, paddy and fodder grass in an area of 4 ha for each crop covering 47, 75 and 35 farmers respectively resulted in 175 kg/ha, 375 kg/ha and 4000 kg/ha increased yield with an additional net returns of Rs.1874/ha, Rs.4793/ha and Rs.19240/ha respectively (Table 9).

Supplemetal irrigation to cotton

Paddy

Fodder grass

3.4. Soil Quality and fertility Management

Nalgonda

Soil test based fertilizer recommendation and tank silt application were demonstrated in cotton in an area of 15.6 ha and 18.6 ha covering 26 and 31 farmers respectively in the NICRA village of Nalgonda. This practice recorded an additional yield of 140 kg/ha & 237 kg/ha with 29% and 19.5% increased net returns compared to farmers practice (Table 10).

Namakkal

Soil test based fertilizer application in small onion was demonstrated in 40 ha area covering 100 farmers which recorded 11% increase in yield with a higher net income of Rs.122350/ ha over the farmer practice (Table 10).

Ramanathapuram

Recycling of organic matter through vermicompost preparation and its application for improving soil fertility was demonstrated in an area of 42 ha covering 70 farmers in samba chilli. This practice recorded an increased yield of 26% and additional net income of Rs.19850/ha with favourable benefit cost ratio of 3.1 (Table 10).

Soil test based fertilizer application and vermicompost application were demonstrated in paddy in an area of 62 ha and 15 ha covering 100 and 15 farmers respectively in the NICRA village of Ramanathapuram. This practice recorded an additional net returns of Rs.4345/ha and 10000/ha compared to farmers practice respectively (Table 10).

Thiruvarur

Green manuring in paddy with daincha was practiced for the reclamation of problematic soils in an area of 12 ha covering 30 farmers. This practice recorded 22% increased yield with an additional net income of Rs.16184/ha (Table 10). Soil nutrition status of green manure applied and controlled plots was given in Table 11.

***In-situ* ploughing of daincha**

Table 9: Enhanced performance of crops provided with supplemental irrigation using harvested water

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Khammam	Cotton	Rainfed	47	4	1775	57229	79875	28647	1.5
		Supplemental irrigation			1950	51350	87750	30521	1.7
	Paddy	Rainfed	75	4	5437	53142	95156	42014	1.8
		Supplemental irrigation			5812	54912	101719	46807	1.9
	Fodder grass	Rainfed	35	4	8750	33750	43750	10000	1.3
		Supplemental irrigation			12750	34510	63750	29240	1.8

Table 10: Soil quality and fertility management in different NICRA centers

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Nalgonda	Cotton	Farmers practice	26	15.6	1770	60625	90270	29645	1.5
		Soil test based fertilizer application			1910	58817	97034	38217	1.6
	Cotton	Farmers practice	31	18.6	1790	58600	91290	32690	1.5
		Tank silt application			2027	63175	102261	39086	1.6
Namakkal	Small onion	Farmers practice	100	40	12360	89600	185400	95800	2.0
		Soil test based fertilizer application			13720	83450	205800	122350	2.5
Ramanathapuram	Samba Chilli	Farmers practice	70	42	700	31500	84000	52500	2.7
		Vermi-compost application			880	33250	105600	72350	3.1
	Paddy	Farmers practice	100	62	3080	22420	46200	23780	2.0
		Soil test based fertilizer application			3425	23250	51375	28125	2.2
		Farmers practice	15	15	3330	22850	49950	27100	2.2
		Vermi-compost application			4020	23200	60300	37100	2.6
Thiruvarur	Paddy	No green manuring	30	12	4995	38111	81918	43807	2.1
		Green manuring with *Dhaincha*			6092	39917	99908	59991	2.5

Table 11: Soil Nutrient status of Green manure applied plot and control plot - Thiruvarur

Particulars	Before intervention	After intervention
Electrical conductivity (dS/m)	0.26	0.24
pH	8.33	8.05
Organic carbon (%)	0.53	0.54
Available Nitrogen (kg /ha)	215.00	238.00
Available Phosphorus (kg /ha)	14.20	14.60
Available Potassium (kg /ha)	206.00	210.00

4. Crop Production

4.1. Climate Resilient crop cultivars

Flood tolerant varieties

Srikakulam

Flood tolerant varieties, MTU-1061, MTU-1075 and RGL-2537 recorded higher yield of 4612, 4025 and 4490 kg/ha respectively over the farmers varieties MTU-7029 (3624 kg/ha) and MTU-1001 (3856 kg/ha) with additional net returns (Table 12).

MTU-1061

RGL-2537

West Godavari

Flood tolerant varieties MTU-1061 and MTU-1064 recorded an additional yield of 253 and 190 kg/ ha over the farmers variety MTU-7029 with 8.3% and 6.2% increase in net returns respectively (Table 12).

MTU-1064

MTU-1061

Table 12: Performance of flood tolerant varieties during 2018-19

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Srikakulam	Paddy	Farmers practice (MTU-1001)	39	32	3856	37200	61696	24496	1.6
		Farmers practice (MTU- 7029)			3624	34400	57984	23584	1.7
		Improved variety (MTU-1075)			4025	36400	64400	28000	1.7
		Improved variety (MTU-1061)			4612	37400	73792	36392	2.0
		Improved variety (RGL-2537)			4490	37400	71840	34440	1.9
West Godavari	Paddy	Farmers practice (MTU-7029/Swarna)	15	5	7040	55877	95040	39163	1.7
		Improved variety (MTU-1140/ Bhima)			7652	55877	103302	47425	1.8
		Farmers practice (MTU- 7029)	50	40	7172	55628	96822	41194	1.7
		Improved variety (MTU-1061)			7425	55628	100238	44610	1.8
		Improved variety (MTU-1064)			7362	55640	99387	43747	1.8
Thiruvarur	Paddy	Farmers practice (CR 1009)	75	30	4256	35620	69798	34178	2.0
		Improved variety (CR 1009 SUB 1)			5656	38125	92758	54633	2.4
		Farmers practice (BPT 5204)	85	34	4868	31550	79835	48285	2.5
		Improved variety (Swarna Sub 1)			5975	34375	97990	63615	2.8

Thiruvarur

Flood tolerant long duration paddy variety at Thiruvarur district *viz.,* CR 1009 SUB 1 recorded higher yield (5656 Kg/ha) compared to the farmers variety CR 1009 (4256 Kg/ha) with a favourable B:C ratio of 2.4. Medium duration variety of Swarna Sub 1 (5975 Kg/ha) which is also a flood tolerant variety reported higher yields than farmers variety BPT 5204 (4868 Kg/ha) with an additional net income of Rs.15330/ha (Table 12).

CR 1009 SUB 1

Biotic and abiotic stress tolerant varieties

Anantapur

Climate resilient varieties of groundnut (Harithandra) and jowar (NJ-2446) were demonstrated in an area of 20 ha & 4 ha covering 10 farmers each respectively in the NICRA village. Harithandra recorded 212 kg/ha higher yield compared to traditional K-6 variety. NJ-2446 showed 47.05% increase in yield with an additional net returns of Rs.20942/ha over farmers variety (Table 13).

K-6 variety (left) & Harithandra variety (right)

Jowar (NJ-2446)

Chittoor

Demonstrations were conducted with the drought tolerant groundnut variety, Dharani under rainfed situation at NICRA village in 8 ha covering 20 farmers About 24.22% increase in yield was observed in Dharani when compared to Kadiri-6. An amount of Rs.6419/ha was realized as additional net returns by the farmers with a B:C ratio of 1.4 (Table 13).

KVK supplied tomato seedlings of **'Arka samrat'** variety to 10 members for demonstration purpose. Both the farmer variety (US 448) and Arka Samrat variety were severely affected with Bacterial leaf spot due to continuous rains and cloudy weather during kharif season, 2018. Arka samrat variety showed 14.7% higher yield than farmers variety. Early blight was not noticed in Arka Samrat whereas US 448 was affected with 1-10% disease incidence.

Groundnut (Dharani)

Tomato (Arka samrat)

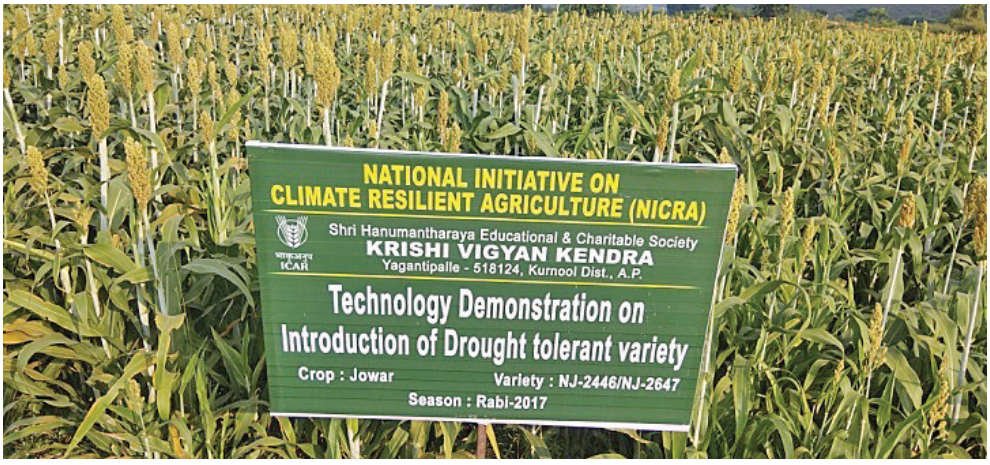
Kurnool

The drought tolerant variety of redgram PRG-176 which is suitable to medium to light soils and has 140-150 days duration was demonstrated against long duration (180 days) variety (Asha) which faces moisture stress at flowering and pod development stage (terminal moisture stress) in the NICRA village of Kurnool where drought in the major climatic vulnerability.

The results indicated that redgram variety PRG-176 with improved production technologies gave higher yield (438 kg/ha) which was 13.47% than that of farmers practice (386 kg/ha) in medium black soils. The Economic viability of improved technology over farmers practice was calculated depending on prevailing prices of input and output costs. The improved technologies resulted in increased income with cost benefit ratio of 1.4 (Table 13).

Improved variety in Bengalgram (NBeG-3), which is fairly drought tolerant with well-developed root system and also resistant to wilt diseases was demonstrated in an area of 25 ha covering 10 farmers NBeG-3 showed 14.46% increased in yield because of more no. of pods/plant and higher 100 grain weight with an additional net returns of Rs.3182/ha (Table 13).

Climate resilient jowar varieties, NJ-2647 and NJ-2446 performed well in medium to light soils compared to local varieties. These two varieties showed 9.76% and 4% increase in yield with an additional net returns of Rs.2098/ha & Rs.16735/ha respectively compared to farmers variety (Mahindra male) (Table 13).



Yellow jowar variety, NJ 2647

West Godavari

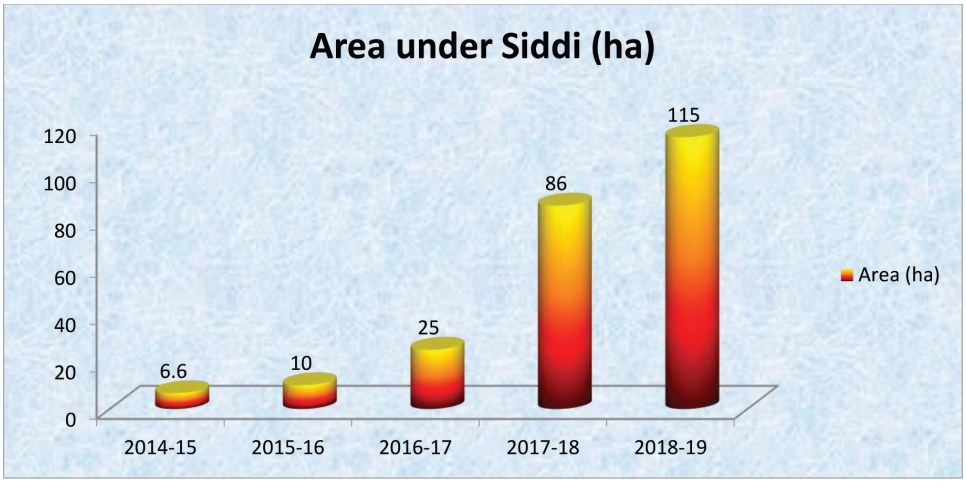
Short duration varieties of paddy *viz.,* MTU-1121 and MTU-1156 were demonstrated in 40 ha area covering 50 farmers with the purpose of escaping from flash floods during harvesting stage which causes heavy losses. The variety MTU-1121 gave high yield (9653 kg/ha) followed by MTU-1156 (9364 kg/ha) compared to the farmers variety *i.e.,* MTU-1010 (8768 kg/ha). Higher net returns of Rs.63641/ha were obtained with MTU-1121 (Table 13).

Khammam

Salinity tolerant Paddy variety Siddi (WGL-44) was demonstrated in an area of 20 ha covering 50 farmers in the NICRA village of Khammam. The improved variety recorded 8.21% increase in yield with a B:C ratio of 1.9 against 1.6 in farmers variety (BPT-5204) (Table 13).

Siddi (WGL- 44)

Spread of Siddi (WGL- 44) in NICRA adopted village from 2014-15 to 2018-19



Drought resistant green gram variety, MGG-351 was demonstrated in an area of 120 ha covering 98 farmers at Khammam district. Improved variety showed an additional yield of 110 kg/ha with 79.40% increase in net income compared to farmers variety (MGG-295) (Table 13).

Green gram (MGG-351)

Nalgonda

Improved varieties of pulses, LRG-52 (medium duration & moderately wilt tolerant) and WGG-42 (YMV tolerant) of pigeonpea and greengram were demonstrated as resilient varieties in the NICRA village. The variety LRG-52 recoded 1050 kg/ha yield with a net income of Rs.27364/ha covering an area of 9.8 ha in 23 farmers fields. WGG-42 recorded 25.45% higher yield over the traditional variety MGG-295 (Table 13).

Pigeon pea (LRG-52)

Green gram (WGG-42)

Namakkal

Climate resilient varieties of groundnut (high yielding, TCGS-1078), blackgram (short duration, VBN-6), greengram (short duration, CO-8) and small onion (high yielding, Co (On) 5) were demonstrated in the NICRA village. Resilient variety TCGS-1078 of groundnut recorded 1035 kg/ha additional yield compared to traditional variety. VBN-6 of blackgram gave additional net returns of Rs.11080/ha over farmers variety. Short duration, synchronized maturing variety of greengram, Co-8 realized additional yield advantage of 280 kg/ha with 72.95% increase in net income over farmers variety VBN-3. Co (On) 5 of small onion variety showed 45.02% increase in yield with a favourable B:C ratio of 2.9 (Table 13).

Groundnut (TCGS-1078)

Blackgram (VBN-6)

Greengram (CO-8)

Small onion (Co (On) 5)

Ramanathapuram

Short duration, high yielding and drought tolerant paddy variety, CO(R)-51 was demonstrated in an area of 5 ha covering 20 farmers over the farmer variety (ADT-46). Improved variety showed 19.38% increase in yield with a favourable B:C ratio of 2.7 (Table 13).

Improved variety, NLR 34449 (high yielding & non-lodging variety) of paddy was demonstrated over Co 46 in an area of 10 ha covering 30 farmers in the NICRA village of Ramanathapuram. The results showed NLR 34449 recorded 565 kg/ha as additional yield with B:C ratio of 2.4 (Table 13).

CO (R) 51 (left) and NLR 34449 (right)

Samba chilli cv. K1 variety of chilli was evaluated for drought tolerance over the conventional variety (Ramnad Mundu chilli). K1 recorded higher yield (210 kg/ha) and net income (24350/ha) with a positive B:C ratio of 3.6 (Table 13).

Samba chilli

Thiruvarur

Short duration and YMV resistant black gram variety, ADT 5 was demonstrated over the farmers variety (T9) in an area of 20 ha covering 50 famers. The results indicated that improved variety showed 16.66% and 27.47% increase in yield and net returns respectively with a B:C ratio of 1.9 (Table 13).

Black gram (ADT 5)

Villupuram

Short duration and disease resistant variety of black gram (VBN 6) was demonstrated in 60 ha area covering 300 farmers. The improved variety showed 33.87% increase in yield with an additional net returns of Rs.11352/ha compared to farmers variety (VBN 3) (Table 13).

Blackgram (VBN 6)

Table 13: Performance of crop cultivars for adaptation to climate variability

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Ananthapur	Groundnut	Farmer practice (K-6)	10	20	475	30650	28064	-2586	1.0
		Harithandra			687	31700	39850	8150	1.3
	Jowar	Farmers variety	10	4	510	17142	25950	8808	1.5
		NJ-2446			750	11500	41250	29750	3.6
Chittoor	Groundnut	Farmers variety (K-6)	20	8	1428	56395	64260	7865	1.1
		Dharani			1774	55668	79830	14284	1.4
	Tomato	Farmers variety (US448)	10	4	44900	103844	149517	45673	1.4
		Arka Samrat			51500	97844	171495	73651	1.8
Kurnool	Pigeonpea	Farmer practice (Asha)	178	142	386	16885	20458	3573	1.2
		PRG-176			438	16885	23214	6329	1.4
	Bengal gram	Farmer practice (JG-11)	10	25	643	19500	28938	9438	1.5
		Improved variety (NBeG-3)			736	20500	33120	12620	1.6
	Jowar	Farmers practice (Mahindra male)	10	10	625	9625	14250	4625	1.5
		Improved variety (NJ-2647)			686	9125	15848	6723	1.7
		NJ-2446 (Yellow Jowar)			650	11540	32900	21360	2.8
West Godavari	Paddy	Farmers practice (MTU 1010)	50	40	8768	66675	1,18,368	51,693	1.8
		Short duration (MTU 1156)			9364	66675	1,26,414	59,739	1.9
		Short duration (MTU 1121)			9653	66675	1,30,316	63,641	1.9

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Khammam	Paddy	Farmers variety (BPT-5204)	50	20	5943	57560	94494	36,934	1.6
		Improved variety (Siddi)			6431	53520	102253	48733	1.9
	Green gram	Farmers variety (MGG-295)	98	120	792	26751	35852	9101	1.3
		Short duration variety (MGG-351)			902	24469	40797	16328	1.7
Nalgonda	Pigeonpea	Farmers variety (LRG-41)	23	9.8	820	28200	45920	17720	1.6
		Improved variety (LRG-52)			1050	31472	58836	27364	1.9
	Green gram	Farmers variety (MGG-295)	33	13.2	330	11050	14850	3800	1.3
		Improved Variety (WGG-42)			414	11251	18782	7531	1.7
Namakkal	Groundnut	Farmers variety	21	106	815	32800	55750	22950	1.7
		Improved Variety (TCGS-1078)			1850	38250	107500	69250	2.8
	Black gram	Farmers variety	16	6.4	565	16380	33900	17520	2.0
		Improved Variety (VBN-6)			769	17540	46140	28600	2.6
	Green gram	Farmers variety (VBN-3)	46	18.4	610	15300	36600	21300	2.4
		Improved Variety (Co-8)			890	16560	53400	36840	3.2
	Small onion	Farmers variety (Co4)	65	26	11360	89600	170400	80800	1.9
		Improved Variety (Co (On) 5)			16475	84150	247125	162975	2.9

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Ramanathapuram	Paddy	Farmers variety (ADT-46)	20	5	3560	22850	53400	30550	2.3
		Short duration Variety (CO (R) -51)			4250	23200	63750	40550	2.7
		Farmers variety (CO 46)	30	10	3375	22850	50625	27775	2.2
		Improved Variety (NLR 34449)			3940	24100	59100	35000	2.4
	Chilli	Farmers practice (Ramnad Mundu chilli)	25	5	840	34500	100800	66300	2.9
		Improved variety (Samba chilli cv. K1)			1050	35350	126000	90650	3.6
Thiruvarur	Blackgram	Farmers variety (T9)	50	20	720	26400	46800	20400	1.8
		Improved Variety (ADT 5)			840	28595	54600	26005	1.9
Villupuram	Blackgram	Farmers variety (VBN 3)	300	60	549	16914	35711	18797	2.1
		Improved Variety (VBN 6)			735	17632	47781	30149	2.7

4.2. Climate resilient intercropping systems

Intercropping is an important aspect than sole cropping to address the issues of rainfed agriculture under changing climate scenario and it also helps in the maximization of productivity and profitability by efficient utilization of natural resources like land, light and water and also help to mitigate the risk of total crop failure during periods of extreme weather events.

Chittoor

To get assured income from diversified crops under drought conditions, demonstration was conducted on intercropping of mango with field bean in an area of 8 ha covering 20 farmers The field bean was sown when mango was at bud initiation stage. An additional income of Rs.52300/ha with a favourable B:C ratio of 2.7 was obtained due to the intercropping system when compared to the sole crop of mango (Table 14).

Intercropping of field bean in mango

KVK, Chittoor supplied pole bean seeds to 10 members for intercropping of tomato in the ratio of 6:1/5:1 in an area of 4 ha. In this intercropping system, tomato crop produced 41.4 tonnes of yield while pole bean had given 1.96 tonnes of pod yield. Additional net returns of Rs.24530/- was obtained from intercropping system when compared to sole crop of tomato (Table 14).

Intercropping of pole bean in tomato

Kurnool

Adverse weather conditions like delayed onset of rains and prolonged dry spells during the crop period is very common in rain fed situation. Such situation results in economic losses to the farmers due to the partial or total failure of the sole crops in NICRA village of Kurnool district. In order to utilize the bi-model distribution of rainfall and also to insure against crop failure due to drought during crop growth period, millet based inter cropping systems were demonstrated as a climate resilient option as against sole crops.

Pigeonpea + foxtail millet (1:5) inter cropping system was demonstrated in comparison with sole crop of redgram and foxtail millet in order to increase the cropping intensity and net returns of the farmers. Results of intercropping in the demonstration plots indicated that net income was higher (Rs.19493/ha) than sole foxtail millet (Rs.669/ha). Besides ensuring higher net returns, the intercropping system with red gram will help sustain fertility and microbial activity of the soil through addition of biomass of pigeonpea (Table 14).

Intercropping of pigeionpea +foxtail millet (1:5)

Srikakulam

Cotton is cultivated under ID situations and is frequently prone to drought or heavy rains during the crop season leading to heavy crop loss. Therefore, an intercrop suited for the situation *i.e.,* red gram is introduced so that an alternative crop is available to the farmer to minimise loss. By raising redgram as intercrop, a net income of Rs.70676/ha was recorded instead of raising cotton as sole crop (Rs. 62870/ha) (Table 14).

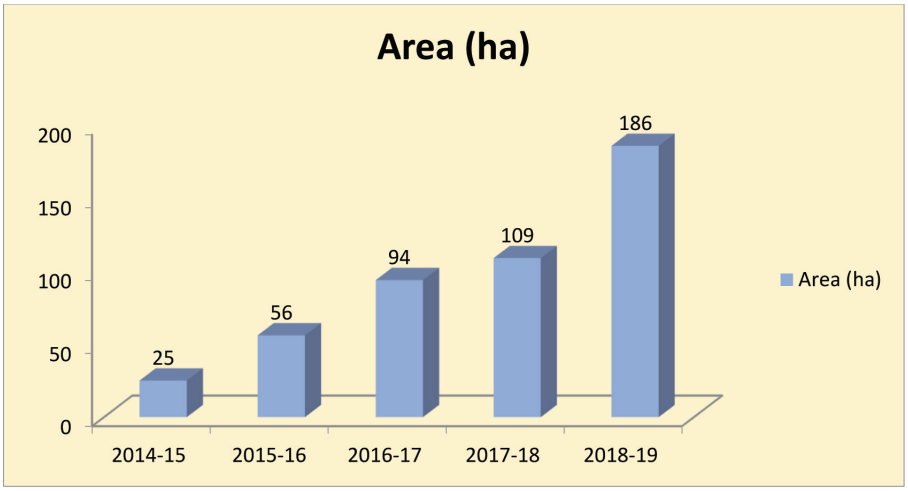
Intercropping of cotton +pigeionpea (6:2)

Khammam

The NICRA village of Khammam received heavy rainfall during the months of September and October when the cotton crop was at flowering and boll bursting stage and as a result cotton crop was damaged heavily. Cotton and pigeonpea intercropping system in 6:1 ratio was taken up for obtaining additional benefit compared to sole cotton. An enhanced net income of Rs. 3716/ha was obtained in intercropping system compared to sole cotton crop (Table 14).

Intercropping of cotton + pigeonpea (6:1)

Adoption of climate resilient intercropping system in Khammam from 2014-15 to 2018-19



Nalgonda

To minimize the risk of low productivity or crop failures and loss of income from crops due to erratic rainfall, cotton + redgram (6:1) intercropping was demonstrated in 7.20 ha area covering 18 farmers in NICRA village of Nalgonda district. The results indicated that, an additional net income of Rs.13364/ha was realized from intercropping system when compared to sole crop of cotton with a B:C ratio of 1.8 (Table 14).

Inter cropping of cotton + pigeonpea (6:1)

Villupuram

Agoor village receives low and erratic rainfall during the crop season. Sole crops fail often or give low yield which leads to less income and sometimes total crop failure occurs due to erratic rainfall and skewed distribution of rain fall. In this condition, intercropping system of groundnut with redgram (6:1) was introduced to get more income per unit area. Groundnut variety TMV 13 which is a short duration, high yielding and terminal drought tolerant variety and redgram VBN 3 seeds were distributed among the farmers. The net income from this intercropping system was Rs.45469/ha which was 30.35% higher when compared to the sole crop (Rs.34880/ha) (Table 14).

Inter cropping of groundnut + pigeonpea (6:1)

Additional net returns (Rs/ha) from intercropping of cotton+ redgram at different KVKs

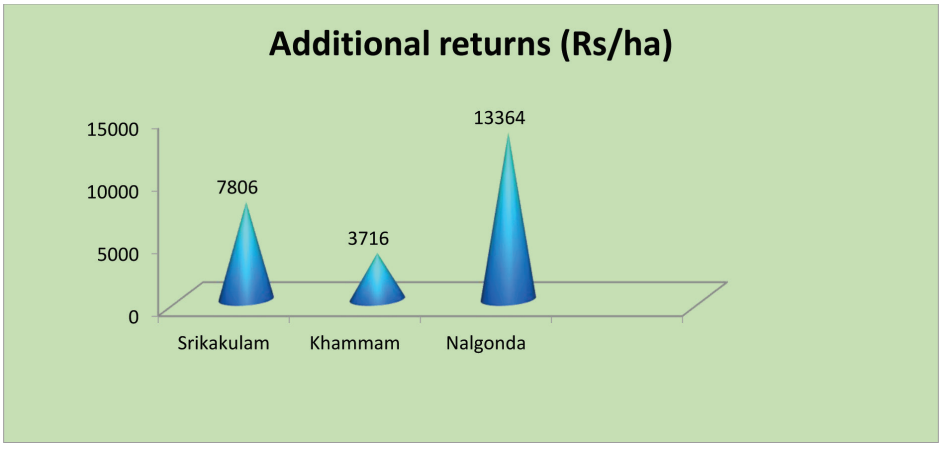


Table 14: Performance of climate resilient cropping systems

KVK	Intervention	No. of demons-trations	Area (ha)	Yield(kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Chittoor	Sole Crop (Mango)	20	8	3750	50875	116800	65925	2.3
	Mango + field bean			6050	67575	185800	118225	2.7
	Sole tomato	10	4	47400	103844	226000	122156	2.1
	Tomato + pole bean			41456 (T)+1960 (P)	102515	249201	146686	2.4
Kurnool	Sole Seteria	25	10	286	8125	8794	669	1.0
	Seteria+redgram			465(S)+ 376 (R)	14520	34013	19493	2.3
Srikakulam	Sole cotton	33	13	1905	40000	102870	62870	2.5
	Cotton+ redgram			1846 (c) + 369(R)	43750	114426	70676	2.6
Khammam	Sole cotton	5	10	1986	61842	89370	27528	1.4
	Cotton+ redgram			1876 (c) +268 (R)	63896	95140	31244	1.5
Nalgonda	Sole cotton	18	7.2	1896	60294	96881	36587	1.6
	Cotton+ redgram			1744(c) + 440 (R)	63210	113161	49951	1.8
Villupuram	Sole groundnut	10	4	2020	35855	70735	34880	2.0
	Groundnut+ redgram			1890 (G)+234 (R)	35955	81423	45469	2.3

4.3. Crop diversification

Diversified cropping pattern is found as an important strategy to cope with risk and uncertainty associated with agriculture due to climatic and biological vagaries. Diversification with climate resilient crop options has been demonstrated in various NICRA centers as an adaptive strategy to mitigate the adverse effects of climatic vulnerability.

Anantapur

Due to continuous mono cropping of groundnut (K-6), farmers realized very low net returns due to delayed sowing because of late on set of monsoon. Crop diversification with the introduction of drought tolerant and short duration variety of castor DCH-519 resulted in higher net returns (Rs.9050/ ha) and B:C ratio (1.8) compared to groundnut (Table 15).

Castor (DCH-519)

Kurnool

Desi cotton is the traditional crop grown in NICRA village of Kurnool district and highly prone to the vagaries of weather resulting in poor productivity. Crop diversification with foxtail millet was demonstrated as a drought mitigation strategy in an area of 10 ha covering 5 farmers. The adoption of foxtail millet by the farmers was due to its suitability to delayed monsoon, short duration and additional benefit of fodder. The market price of foxtail millet is also on a rise due to growing awareness among consumers on the benefits of including millets in the diet. Comparison of economics of demonstration and farmers practice indicated that the cultivation of alternative crop of foxtail millet with improved technologies ensured additional net returns of Rs.2392/ha with B:C ratio of 1.8. In view of drought tolerance and minimum requirement of water, foxtail millet is preferred over desi cotton by farmers. Because of sustainable yield and income obtained even under harsh weather conditions,

the cropped area under foxtail millet increased from 05 to 250 acres in the NICRA village during kharif, 2018 (Table 15).

Foxtail millet (SIA-3085)

Instead of leaving the land fallow before rabi, cultivation of Dolichos was demonstrated in an area of 1 ha covering 5 farmers at NICRA village of Kurnool. Dolichos cultivation earned an additional net income of Rs. 30700/ha with a B:C ratio of 1.7 (Table 15).

Srikakulam

Farmers grow blackgram in rice fallows to utilize residual soil moisture available after paddy harvesting during *rabi* season. Very low yields of blackgram are realized due to low temperatures prevailing during the cropping season. Crop diversification with sesamum and ragi in rabi was found remunerative over pulses. The performance of sesamum was observed to be better both in terms of yield (491 kg/ha) and net returns (Rs.28280/ha) over black gram with an additional net returns of Rs.27235/ha with a B:C ratio of 3.6 (Table 15).

Sesamum (YLM-66)

Ragi

Khammam

Cultivation of cotton has been a traditional practice in the NICRA village of Khammam. Frequent and intermittent droughts have been adversely affecting the productivity of the crop in the village. Redgram (WRG-65) was demonstrated as an alternative to cotton which resulted in an additional net income of Rs.8649/ha compared to farmers practice with a benefit cost ratio of 1.6 (Table 15).


Redgram (WRG-65) field

Due to non-availability of water in rabi season, demonstrations were given for intensification of cropping in paddy fallows with sunhemp for seed production to utilize the residual moisture in the soil in an area of 64 ha covering 68 farmers. The results showed, 83.7% decreased cost of cultivation with a good B:C ratio of 5.2 compared to farmers practice of leaving paddy fields fallow (1.8) (Table 15).


Sunhemp seed production plots

Villupuram

Pulses are the major crops grown in Agoor village of Mailam block. The income received from pulses is very low due to monocropping in larger area which fetches lower prices. Hence, amaranthus (PLR 1) and ragi (Co 15) were introduced as alternative crops to blackgram for getting regular and stable income. Cultivation of amaranthus and ragi was found remunerative over farmer practice with net returns of Rs.14384/ha and Rs.30747/ha respectively (Table 15).

Amaranthus (PLR 1)

Ragi (Co 15)

Table 15: Crop diversification for sustainability in different NICRA centers

KVK	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Anantapur	Groundnut (K-6)	4	10	277	26875	16487	-10388	0.6
	Diversification with Castor (DCH-519)			419	11750	20800	9050	1.8
Kurnool	Desi cotton	5	10	225	7862	11700	3838	1.5
	Diversification with Fox tail millet (SIA-3088)			495	8125	14355	6230	1.8
	Farmer practice					**Fallow**		
	Diversification with Dolichos,	5	1	3650	42500	73200	30700	1.7
Srikakulam	Blackgram	10	4	301	12500	13545	1045	1.1
	Diversification with Sesamum			491	11000	39280	28280	3.6
	Diversification with ragi			891	13750	17820	4070	1.3
Khammam	Cotton	45	125	1762	67115	79321	12206	1.2
	Diversified with redgram (WRG-65)			1432	36425	57280	20855	1.6
	Paddy (BPT- 5204)	68	64	6130	58220	107275	49055	1.8
	Diversification with Sunhemp			991	9500	49550	40050	5.2
Villupuram	Blackgram	10	1	1333	10266	15996	5730	1.6
	Diversification with Amaranthus (PLR 1)			2072	10486	24870	14384	2.4
	Blackgram	10	4	1793	10158	35868	25710	3.5
	Diversification with Ragi (Co 15)			2094	11125	41872	30747	3.8

4.4. Farm mechanization for resource conservation

Kurnool

Traditional method of sowing Bengalgram with bullocks involves high cost, less coverage and less precision. To circumvent these demerits associated with this method of sowing, farm mechanization was opted as an alternative which would reduce the cost of sowing, increase the precision and cover more area in unit time especially during periods of labour shortage. Ten demonstrations were conducted on sowing Bengalgram with improved seed drill in 10ha of area. The demonstrations gave higher net income of Rs.7440/ha and reduced cost of cultivation by Rs.1500/ha compared to farmer practice. Similarly sowing with seed drill in sorghum resulted in additional net income of Rs.4080/ha and reduced cost of cultivation by Rs.680/ha (Table 16).

Sowing with seed drill

Ramanathapuram

Sowing paddy with seed drill in 55 ha area covering 65 farmers resulted in an additional yield of 550 kg/ha with 31.73% increase in net returns compared to farmer practice (Broadcasting) (Table 16).

Sowing Paddy with seed drill

Table 16: Influence of farm implements on yield and economics of crops in NICRA villages

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Kurnool	Bengalgram	Farmer practice	10	10	684	22500	30780	8280	1.4
		Improved seed drill			816	21000	36720	15720	1.7
	Jowar	Farmer practice	10	10	615	11680	12300	620	1.0
		Improved seed drill			785	11000	15700	4700	1.4
Ramanathapuram	Paddy	Farmer practice (Broadcasting)	65	55	2960	22500	44400	21900	2.0
		Seed drill sowing			3510	23800	52650	28850	2.2

4.5. Resource/ Water saving technologies

Chittoor

Direct seeding in paddy using drum seeder conserves seed, water, labour and allows the crop to produce more tillers. The improved practice resulted in higher yield (16.21%) over conventional method of planting and ensured higher net returns of Rs.23594/ha. No. of tillers per plant (15) were higher in drum seeder technology as compared to normal practice (9) (Table 18).

Direct seeding with drum seeder in Paddy

Srikakulam

Zero tillage in maize was followed to utilize residual soil moisture available in rice fallows. The results showed an additional yield advantage of 211 kg/ha with an extra net income of Rs.7520/ha compared to farmers practice. Cost of cultivation was also reduced by Rs.3300/ ha compared to normal method of cultivating maize (Table 18).

Zero tillage in Maize

West Godavari

Direct sowing with drum seeder in paddy is useful to reduce the cost of cultivation and to improve the water use efficiency. This improved technology reduced the cost of cultivation to Rs.10910/ha with additional yield advantage of 810 kg/ha compared to traditional practice in the demonstrations conducted at 50 locations on 40 ha of area. Other measurable indicators like no. of tillers/plant, grain wt. was plant was increased and crop duration reduced by 10 days (Table 18).

Direct seeding with drum seeder in Paddy

Drum seeder sown paddy field

Namakkal

Laser spray micro irrigation system was demonstrated in small onion and groundnut in order to utilize the stored water in a more efficient manner, to minimize the use of water and to increase the area of cultivation. The results indicated that, an additional yield of 320 kg/ha and 2620 kg/ha with 80.34% and 36.18% increase in net returns were obtained compared to farmers practice (flood irrigation) respectively (Table 18).


Micro irrigation in groundnut


Micro irrigation in small onion

Thiruvarur

System of rice Intensification (SRI) was demonstrated in an area of 10 ha covering 25 farmers in the NICRA village to reduce the cost of cultivation and to improve water use efficiency. The SRI method resulted in 1071 kg/ha increase in yield with additional net income of Rs.20014/ha compared to traditional method of cultivation (Table 18). Other measurable indicators like plant height (cm), no. of tillers/plant, no of productive tillers/ plant, panicle length (cm) was increased and water consumption was reduced by 86.73 mm/ ha compared to flooding method (Table 17).

Table 17: Other measurable indicators

Parameters	Demo	Farmer Practice
Plant height (cm)	105.9	103.0
No of tillers per plant	26.0	22.0
No of productive tillers per plant	25.0	21.0
Panicle length (cm)	23.8	21.5
Water consumed (mm /ha)	893.3	980.0

Villupuram

Rice requires more number of supplemental irrigations due to larger dry spells during *kharif*. Moreover it has been observed many times that transplanting delayed due to late on set of monsoon results in poor yield. Hence, the farmers in the NICRA village are motivated to adopt alternate wetting and drying method (Pani-pipe) to conserve the water by reducing the number of irrigations and increase the ground water level. The benefits of alternate wetting and drying method have been popularized in Agoor village of Mailam block through off campus trainings. The pani-pipes have been distributed to the farmers for adopting this technology. The results revealed that the number of irrigations in rice field was reduced by 12 to 15. The average yield was 4900 kg/ha which was 4.47% higher when compared to the control plot (4690 kg/ha) (Table 18).

Pani pipe technology in paddy field

Table 18: Effect of water saving technologies on productivity and profitability of different crops

KVK	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Chittoor	Farmer practice (Transplanting)	2	0.4	4840	51724	70987	19263	1.4
	Direct seeding with drum seeder in Paddy			5625	39643	82500	42857	2.1
Srikakulam	Farmer practice	42	32	5351	42500	107020	64520	2.5
	Zero Tillage Maize			5562	39200	111240	72040	2.8
West Godavari	Farmer practice (Transplanting)	50	40	9188	66225	124038	57813	1.9
	Direct seeding with drum seeder in Paddy			9998	55315	134973	79658	2.4
Namakkal	Farmer practice (Flood irrigation)	8	1.6	760	31700	51800	20100	1.6
	Laser spray micro irrigation in groundnut			1080	32750	69000	36250	2.1
	Farmer practice (Flood irrigation)	8	1.6	10730	82750	160950	78200	1.9
	Laser spray micro irrigation in small onion			13350	93750	200250	106500	2.1
Thiruvarur	Farmer practice (Flood irrigation)	25	10	4599	33500	75424	41924	2.2
	SRI cultivation in paddy			5670	31050	92988	61938	3.0
Villupuram	Farmer practice (Flood irrigation)	10	4	4690	41470	75024	33554	1.8
	Pani pipe in paddy			4900	41795	78400	36605	1.9

4.6. Nutrient Management

Chittoor

Micro-nutrient management in mango using IIHR mango special was demonstrated covering 25 farmers over 25 ha area. In the demonstrations, fruit yield was increased by 22.46% when compared to farmers practice. Additional net returns of Rs.24010/ha was obtained in the demonstration with a benefit cost ratio of 2.8 (Table 19).

West Godavari

Indiscriminate use of chemical fertilizers is leading to high cost of cultivation and lower yield in paddy. Use of liquid bio-fertilizers (1250 ml of Azospirillum + 1250 ml of PSB + 75% RDF (100 kg Urea+ 100 Kg DAP + 100 Kg MOP/ha) enhanced paddy yields by 360 kg/ha by reducing the cost of cultivation of Rs.4500/ha over farmers practice with a favourable B:C ratio of 1.9 (Table 19).

Application of biofertilizers in farmers field at NICRA adopted Village

Nalgonda

Demonstration of foliar nutrient application (1% KNO3 and 2% of urea) in cotton covering 12 farmers in 9.6 ha area recorded additional yield of 159 kg/ha and net income of Rs.5567/ ha over farmers practice with B:C ratio of 1.6 (Table 19).

Foliar nutrient application in cotton

Ramanathapuram

Spraying of PPFM to mitigate the terminal drought in paddy was demonstrated in an area of 28 ha covering 70 farmers. The results indicated 17.27% and 27.92% increase in yield and net returns respectively with a B:C ratio of 2.6 was recorded in demo plot compared to farmer practice (Table 19). Biofertilizers application (*Azospirillum & Phosphobacteria*) in paddy covering 33 farmers in 10 ha area, recorded additional yield of 815kg/ha and 735 kg/ha and net income of Rs.10470/ha and Rs.12540/ha respectively over farmers practice (Table 19).

Spraying of PPFM

Table 19: Effect of nutrient management practices on productivity and profitability of different crops

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Chittoor	Mango	Farmers practice	25	25	3650	48025	116800	68775	2.4
		Micronutrient mixture			4470	50255	143040	92785	2.8
West Godavari	Paddy	Farmer practice	50	20	7329	60031	98942	38911	1.6
		Liquid bio fertilizers			7689	55,531	103802	48271	1.9
Nalgonda	Cotton	Farmers practice	12	9.6	1725	57000	87975	30975	1.5
		Foliar nutrient application			1884	58969	95511	36542	1.6

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Ramanatha puram	Paddy	Farmers practice	70	28	3560	23050	53400	30350	2.3
		PPFM Spray for drought mitigation			4175	23800	62625	38825	2.6
		Farmers practice	33	10	3365	22650	48920	26270	2.2
		Biofertilizer application (*Azospirillum*)			4180	24800	61540	36740	2.5
		Farmers practice	33	10	3325	22540	47630	25090	2.1
		Biofertilizer application (Phosphobacteria)			4060	24650	62280	37630	2.5

4.7. Crop Protection

Chittoor

Leaf miner is a serious pest of tomato, farmers use pesticides indiscriminately to control the pest leading to higher cost of cultivation. KVK supplied WOTA traps, Tuta lures and 1500 ppm neem oil to 20 farmers covering 4 ha for conducting demonstrations on IPM of leaf miner in tomato. Results clearly indicated that an average of 28.8% yield increase was obtained in the demonstration over farmers practice. The demonstration received only two pesticide sprays whereas four pesticide sprays were given in farmers practice. The study also showed good impact on reducing pesticide usage with cost savings of Rs.13000/- per ha in the demonstration as against farmers practice (Table 20).

IPM in tomato

Kurnool

Management of sucking pests in Bt cotton by following IPM practices was demonstrated in NICRA village. The crop was infested with sucking pests *viz.,* aphids, jassids and whiteflies due to continuous dry spells that prevailed after sowing. Stem application with imidacloprid and monocrotophos at 20, 40 and 60 DAS and installation of yellow sticky traps @ 25/ha and need based spraying of imidacloprid @ 0.25ml/l checked the incidence of whiteflies effectively in the demonstrations resulting in healthy plants compared to farmers practice. IPM treated plots recorded 15.11% increase in yield with an additional net income of Rs.14115/ha over the farmer practice (Table 20).

Method demonstration on sucking pest management in Bt-cotton

Srikakulam

Biotic stress management in flood prone area for the management of paddy sheath blight, blast and brown plant hopper was demonstrated to reduce the yield loss because of disease incidence during floods. The improved practice involves seed treatment, formation of alleyways, need based chemical spray for blast, sheath blight and brown plant hopper which resulted in additional yield advantage of paddy over no plant protection measures with very low incidence of pests and diseases. This improved technology gave an additional yield of 255 kg/ha which is 9.51% increase in net income with B:C ratio of 1.9 compared to farmers practice (Table 20).

Particulars	Demo	Farmers practice
Blast Incidence (%)	11.9	17.3
Sheath blight incidence (%)	16.5	22.9
BPH incidence (%)	5.8	11.4
Productive tillers per square meter (No.)	279.0	243.0
Grains per panicle (No.)	141.0	124.0
Yield kg/ha	4507.0	4252.0
B:C ratio	1.9	1.8

IPM in paddy

West Godavari

IPM technology (Seed treatment with Carbendazim, vlipping of leaf tips, erection of Pheromone traps, formation of alley ways, release of *Trichogramma* parasitoid and need based application of chemical pesticides) was demonstrated in paddy covering 50 farmers in an area of 20 ha. The results indicated that, an additional net income of Rs.8915/ha with B:C ratio of 1.9 was realized compared to farmers practice (Table 20).

Namakkal

Onion is mainly affected by basal rot and thrips resulting in a yield loss of 20-30%. To avoid the yield loss IPDM (Integrated Pest & Disease Management) technology which include bulb treatment and soil application of *Trichoderma viride* + *Pseudomonas fluorescence,* soil application of *AM Fungi* (VAM), barrier crop with hybrid maize and blue sticky trap was demonstrated in NICRA village in an area of 26 ha covering 65 farmers. The demonstration gave an yield advantage of 1000 kg/ha with additional net returns of 15860/ha compared to farmers practice (Table 20).

Thiruvarur

IPM technology (application of *pseudomonas*, installation of pheromone trap and releasing of *Tricogramma* cards) to reduce pest and disease incidence in paddy was demonstrated in an area of 4 ha covering 10 farmers. The results showed 20.96% increase in yield which leads to additional net income of Rs.14525/ha with a B:C ratio of 2.8 in IPM plot compared to farmers practice (Table 20).

Demo on IPM in paddy

Distribution of *Trichogramma* card

Villupuram

In order to reduce the yield losses through high incidence of pest and diseases IPDM practices *i.e.,* release of *Trichogramma*, installation of pheromone traps and use of bio control agents etc., was demonstrated in an area of 4 ha covering 10 farmers IPM treated plot showed 23.04% increase in yield with B:C ratio of 2.0 compared to farmers practice (Table 20).

Table 20: Effect of crop protection measures on productivity and profitability of different crops

KVK	Crop	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Chittoor	Tomato	Farmers practice	20	4	46200	106344	231150	124806	2.2
		IPM in leaf miner			59500	93344	297500	204156	3.2
Kurnool	Bt cotton	Farmers practice	25	10	1422	25364	73944	48580	2.9
		IPM			1637	22434	85129	62695	3.8
Srikakulam	Paddy	Farmers practice	20	40	4252	36700	68032	31332	1.8
		IPM			4507	37800	72112	34312	1.9
West Godavari	Paddy	Farmers practice	50	20	7068	55976	95,418	39442	1.7
		IPM			7358	50976	99,333	48357	1.9
Namakkal	Small onion	Farmers practice	65	26	10400	74860	156000	81140	2.1
		IPDM			11400	78500	175500	97000	2.2
Thiruvarur	Paddy	Farmers practice	10	4	4650	31675	76260	44585	2.4
		IPM			5625	33140	92250	59110	2.8
Villupuram	Paddy	Farmers practice	10	4	4340	41045	69408	28363	1.7
		IPDM			5340	41446	85376	43930	2.0

4.8. Integrated Farming System (IFS)

Integration of various agricultural enterprises *viz*., cropping, animal husbandry, fishery, forestry etc., have great potentialities in the agricultural economy. These enterprises not only supplement the income of the farmers but also help in increasing the family labour employment. The integrated farming system approach introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. The farm wastes are better recycled for productive purposes in the integrated system and judicious mix of agricultural enterprises like livestock, poultry, fishery, vermicompost production etc., suited to the given agro-climatic conditions and socio-economic status of the farmers would bring prosperity in the farming.

Anantapur

KVK, Anantapur, demonstrated IFS model in 2 ha area under irrigated conditions by covering 5 farmers. Under this IFS model, cow pea, cluster bean and paddy are cultivated in kharif and during the rabi marigold, okra, paddy, brinjal and fodder grass are grown along with livestock components of Jersey Cows (6), ram lambs (25) and poultry *i.e.,* Rajasri birds (10). It was highly economical with ensured net income of Rs. 941254/-. This was mainly due to intensive cultivation of vegetables, flower crops in addition to live stock round the year. On an average overall system recorded favourable B:C ratio of 4.5 (Table 21).

Table 21: Economics of the integrated farming system during 2018-19

Crops	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
Kharif				
Cowpea	90000	483900	393900	5.4
Cluster bean	89500	259600	170100	2.9
Paddy	12000	34500	22500	2.9
Rabi/summer				
Marigold	40300	108000	67700	2.7
Okra	26400	35834	9434	1.3
Paddy	12500	49400	36900	3.9
Brinjal	29100	76800	47700	2.6
Crop component	**299800**	**1048034**	**748234**	**3.1**

Crops	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
Jersey Cows	223500	357120 per 8 months	133620	1.9
Ram lambs	40000	95000	55000	2.4
Poultry (Rajasri)	1600	6000	4400	3.7
Animal component	**265100**	**458120**	**193020**	**2.7**
Overall system	**564900**	**1506154**	**941254**	**4.5**

IFS model

Marigold

Paddy

Cattle

Sheep

West Godavari

Paddy cum fish culture was demonstrated in an area of 2.5 ha covering 5 farmers over the farmer practice (monocropping of paddy). The results indicated an additional net income of Rs. 63750/ha with a B:C ratio of 2.1 compared to farmers practice (Table 22).

Table 22: Performance of paddy cum fish culture at West Godavari

Intervention	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Farmers practice	122500	222500	100000	1.8
Paddy cum fish culture	143750	307500	163750	2.1

5. Livestock and Fisheries

5.1. Performance of improved fodder varieties

Chittoor

One of the major livestock enterprises in the NICRA village is dairy. Some of the farmers are growing APBN-1 fodder variety for rearing of cattle. Late onset of monsoon and recurring drought situation creates scarcity of green fodder before kharif season. Farmers rely on paddy straw procured from nearby paddy growing mandals for feeding animals during such situations. Keeping in view the problem of shortage of green fodder, KVK conducted demonstrations of improved and drought resistant Hybrid Napier Co-4 fodder variety at ten locations by supplying slips to 10 dairy farmers. Hybrid Napier Co-4 gave higher fodder yield (96.5 t/ha) compared to farmers variety, APBN-1 (84.2 t/ha) (Table 23).

Hybrid Napier Co-4

Improved fodder variety CoFS-31 (multi cut) was also demonstrated in 50 farmers fields covering an area of 6 ha and the variety gave an additional yield of 28 t/ha with a benefit cost ratio of 1.8 over the farmers practice (Table 23).

CoFS-31 (multi cut)

Nalgonda

Improved fodder variety APBN-1 was demonstrated at 5 locations by supplying slips to farmers by covering an area of 2.5 ha against farmers variety MP chari. APBN-1 gave a higher yield of 165 t/ha with a benefit cost ratio of 6.2 over the farmers practice (Table 23).

APBN-1 fodder slips distribution to farmers

APBN-1 fodder

Villupuram

Demonstrations were conducted on CoFS-29 (Multicut fodder sorghum), COBN-5 (Cumbu Napier Grass), GG-3 (Guinea Grass) and Stylosanthes in an area of 2.4 ha covering 30 farmers under each variety and the fodder varieties showed an yield advantage of 38 t/ha, 268 t/ha, 195 t/ha and 28t/ha respectively compared to farmers practice (Table 23).

COBN-5 (Cumbu Napier Grass)

CoFS-29

Table 23: Performance of improved fodder varieties at different NICRA centers

KVK	Intervention	No. of demonstr-ations	Area (ha)	Yield (t/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Chittoor	Farmers practice (APBN-1)	10	1	84.2	47120	84200	37080	1.8
	Hybrid Napier Co-4			96.5	48680	96500	47820	2.0
	Farmers practice (APBN-1)	50	6	157	38425	54000	15575	1.4
	CoFS-31			185	39740	70000	30260	1.8
Nalgonda	Farmers practice (MP-Chari)	5	2.5	63	41600	192000	151900	4.6
	Improved varieties (APBN-1)			165	81200	510000	441500	6.2
Villupuram	Farmers practice (Open grazing)	30	2.4					
	Improved varieties (COFS-29)			38	14500	40000	25500	2.7
	Farmers practice (Open grazing+ Co-4)	30	2.4	220	30000	89000	59000	2.9
	Improved varieties (COBN-5)			268	30000	112500	82500	3.8
	Farmers practice (Open grazing)	30	2.4					
	Improved varieties (GG-3)			195	22000	96000	74000	4.6
	Farmers practice (Open grazing)	30	2.4					
	Improved varieties (Stylosanthes)			28	3500	8200	4700	2.3

Khammam

Demonstrations were given on COFs-29 and Super Napier fodder varieties over farmer practice (Sugar graze) by KVK, Khammam. CoFs-29 showed 54.36% increase in yield and an additional milk yield of 1.2 l/day compared to Sugar graze. Another fodder variety, Super Napier also showed better performance than farmer practice in both fodder and milk yield (Table 24).

Table 24: Effect of improved fodder varieties on milk yield of livestock

Fodder variety	Fodder Yield (t/ha/season)	Milk yield (lt/day)
Farmer practice (Sugar graze)	10.3	4.9
CO Fs-29	15.9	6.1
Farmer practice (Sugar graze)	9.7	4.8
Super Napier	12.0	6.4

CO – Fs -29

Super Napier fodder

Namakkal

Demonstrations were conducted on CoFs-29 fodder variety in NICRA village of Namakkal district to avoid fodder scarcity during lean periods to livestock. The results showed increase in milk production by 1.5 l/day with an additional net returns of Rs.5800/- peak lactation of 100 days by feeding with improved fodder variety compared to farmers practice with a favourable B:C ratio of 2.2 (Table 25).

Table 25: Effect of improved fodder varieties on economic parameters of livestock

Parameter with unit	Demo (CoFs-29)	Check
Milk yield (l/day)	7.0	5.5
SNF content (%)	7.8	7.8
Fat content (%)	4.0	3.5
Gross cost (Rs.)/6 month	14400	11880
Gross return (Rs.)/ peak lactation 100 days	31500	23100
Net return (Rs.)/ peak lactation 100 days	17100	11300
B:C ratio	2.2	1.9

CoFs-29

5.2. Hydroponic fodder production

Kurnool

Low cost hydroponic technology was demonstrated at NICRA villages of Kurnool district to overcome the green fodder scarcity with available limited source of water. It is very effective technology suitable to drought prone areas. 8kg fodder can be grown from 1kg maize seed within seven days. Each animal was offered 12kg hydroponically grown maize fodder along with 7kg jowar straw every day. The results indicated that there was increase of 18.85% milk yield/60 days with a favourable B:C ratio of 4.9 compared to farmers practice. It was also observed that, through feeding of hydroponic fodder the concentrates can be reduced (Table 26).

Table 26: Hydroponic fodder production at Kurnool

Observation	Milk yield (60days)	Fat in milk	6% FCM	B:C ratio
Farmers practice (Dry fodder + concentrates)	328.8	6.78	5.97	3.83
Demo: Dry fodder + Hydroponic fodder 12kg	390.8	7.08	7.32	4.86

Hydrophonic fodder production and feeding to livestock

5.3. Green fodder preservation through silage making

Silage making is a process of chopping available green fodder (sorghum, maize, hybrid napier, sugar cane tops etc.) with a chaff cutter and storing it in air tight plastic bags after some treatment. Silage thus prepared can be stored for 8-10 months and can be used during times of scarcity of green fodder. This method circumvents the problem of purchasing green fodder during summer months at high cost leading to increased cost of milk production. Silage making saves cost of labour required for fodder cutting and transporting. Farmers of NICRA villages prepared silage whenever green fodder/plant material is available to them in plenty to meet the requirement of fodder during lean months.

Kurnool

Demonstration on silage making was conducted by KVK, Kurnool with available crop residues at NICRA village. The results indicated, an additional milk yield of 105 lt/90 days and 0.4% increase in fat content with a B:C ratio of 4.9 compared to farmers practice (Table 27).

Table 27: Effect of feeding silage on economic parameters of livestock at Kurnool

Intervention	Milk yield (l/90 days)	Fat in milk (%)	6% FCM	B:C ratio
Farmers practice (Dry fodder + concentrates)	441	6.78	6.21	3.8
Silage + dry fodder	546	7.18	7.32	4.9

Buffalo feeding on silage

Namakkal

Silage making was taken up at NICRA village of Namakkal, Tamil Nadu to make available green nutritious fodder during scarcity period by using small onion crop residues. The practice of silage making reduced the cost of fodder by Rs.3000/100 days and increased milk production (8.77%) with a B:C ratio of 2.3 compared to check. Net returns per peak lactation of 100 days are also higher by Rs. 5060/- when the cows are fed with silage (Table 28).

Table 28: Effect of feeding silage on economic parameters of livestock at Namakkal

Parameter with unit	Demo	Check
Milk yield (l/day)	6.2	5.7
SNF content (%)	7.8	7.8
Fat content (%)	3.4	3.4
Gross cost (Rs.)/peak lactation 100 days	12600	15600
Gross return (Rs.)/ peak lactation 100 days	28520	23940
Net return (Rs.)/ peak lactation 100 days	13400	8340
BCR	2.3	1.5

Silage making with onion stocks

Feeding with silage

Villupuram

Silage feeding in Villupuram district was demonstrated covering 10 beneficiaries and the improved practice enhanced milk yield by 5.13% compared to traditional practice. Net returns were also high by Rs.1032/- in the improved method (Table 29).

Table 29: Effect of feeding silage on economic parameters of livestock at Villupuram

Intervention	Milk yield (l/day)	Gross cost/ month (Rs.)	Gross Return / month (Rs.)	Net Return / month (Rs.)	B:C ratio
Farmers practice	7.8	4212	5148	936	1.2
Silage	8.2	4182	6150	1968	1.5

5.4. Feed enrichment techniques

Supplementation of mineral mixture/ mineral blocks to milch animals

Anantapur

Feeding livestock with Regional Specific Mineral Mixture (RSMM) along with farmers practice of feeding resulted in 20.6% increase in milk production with an additional net income of Rs.1125/- compared to the farmers practice in NICRA village of Anantapur (Table 30).

Table 30: Effect of Area specific mineral mixture on milk yield and SNF content in milch animals

Treatment	Average milk yield l/day	SNF (%)	Additional costs incurred/ month (Rs.)	Additional returns (Rs.)	B:C ratio
Farmers practice	2.9	5.7	200	1125	5.6
Feeding of RSMM @ 30-40g/day	3.5	6.5			

Feed enrichment with Urea Molasses Mineral Blocks (UMMB) was demonstrated in NICRA village of Anantapur. Supplementation of minerals through UMMB resulted in 10% increase in milk production with an additional net income of Rs.450/day compared to farmers practice (Table 31).

Table 31: Effect of Urea Molasses Mineral Blocks (UMMB) on milk yield in NICRA adopted villages

Treatment	Average milk yield l/day	Additional costs incurred (Rs.)	Additional returns (Rs.)	B:C ratio
Farmers practice	3	210	450	2.1
UMMB@1 block/10 days	3.3			

Distribution of RSMM Distribution of UMMB

Kurnool

Protein and energy are the major factors influencing milk yield in milch animals. Supplementation of protein and energy along with minerals through urea molasses bricks is very effective and economical practice in low and medium production animals. The demonstration was conducted selecting 10 milch buffaloes. Farmers practice of feeding included feeding of dry fodder and rice bran without supplementation of any minerals whereas improved practice involved feeding of mineral mixture bricks. The animals were allowed to lick the block twice daily for 30 minutes at the time of milking. Feed supplementation with mineral mixture bricks resulted in 20.6% increase in milk yield with B:C ratio of 1.5 compare to farmer practice (Table 32).

Table 32: Influence of urea molasses/mineral mixture on productivity of livestock at KVK, Kurnool

Intervention	Milk Yield l/day	% Fat in milk	Total milk yield (l)	Gross income (Rs.)	B:C ratio
Farmer practice	2.9	7	174	6124	1.5
Urea molasses bricks	3.5	7.6	210	9345	1.0

Licking of urea molasses bricks

Khammam

Feed enrichment with mineral mixture was demonstrated in NICRA village covering 16 farmers of Khammam district, Telangana. Supplementation of minerals through mineral mixture (Calcium, potassium, Iodine, Cobalt, Vit A, Vit D3, Vitamin E, Nictotinamide) along with farmer practice in buffaloes resulted in an additional milk production 39 l/ 60 days compared to farmer practice (Table 33).

Table 33: Effect of mineral mixtures on economic parameters of livestock

Intervention	Period of use	Milk yield l/60 days
Farmer practice (Fodder grass)	----	183
20 kg fodder grass + 10 kg paddy straw + 50 – 100 g mineral mixture	2 months before delivery and milk ending before 2 months	222

Supplying of mineral mixture to dairy farmer

Ramanathapuram

Feeding the livestock with TANUVAS mineral mixture along with farmer practice showed an increased milk yield of 30 l/ 60 days with 33.20% increase in net returns compared to farmers practice (Table 34).

Table 34: Influence of TANUVAS Mineral mixture on productivity of live stock

Treatments	Average milk yield/animal (l/day)	Total milk yield per animal (l/60days)	Cost of feeding (Rs./animal)	Gross Returns (Rs./animal)	Net returns (Rs./animal)
Farmers practice	6.7	402	46000	61750	15750
FP+ TANUVAS mineral mixture	7.2	432	44520	65500	20980

Feeding livestock (small ruminants**)** with mineral salt licks along with farmer practice resulted an additional final weight gain of 5 kg/goat and 42.7% increase in net returns with B:C ratio of 2.4 compared to farmers practice (Table 35).

Table 35: Influence of mineral Salt on productivity of live stock at Ramanathapuram

Particulars	Farmers practice (Grazing and dry fodder)	Treated (Mineral Salt licks + Farmer practice)
Initial body weight (kg/goat)	3.2	3.5
Final body weight (kg/goat)	17.0	22.0
Total gross returns (Rs.)	7650	9900
Total cost (Rs.)	3550	4050
Net returns (Rs.)	4100	5850

Villupuram

Feeding with TANUVAS mineral mixture in livestock resulted in exhibition of estrus signs at 18 months where as in farmers practice the signs were recorded at 24 months. The improved practice also recorded higher net returns of Rs.2425/- animal compared to farmers practice (Table 36).

Table 36: Influence of TANUVAS mineral mixture on productivity of livestock at Villupuram

Treatments	Exhibition of estrus signs	Cost of feeding (Rs./animal)	Gross Returns (Rs./animal)	Net returns (Rs./animal)	B:C ratio
Farmers practice	24 months	8250	20000	11750	2.4
FPF+ TANUVAS mineral mixture	18 months	5825	20000	14175	3.4

Feed enrichment with urea treated paddy straw covering 20 farmers resulted in increased milk yield of 9 l/60 days with an additional net income of Rs.706/- animal (Table 37).

Table 37: Influence of Urea treated paddy straw on productivity of live stock

KVK	Treatments	Average milk yield/ animal (l/ Day)	Total milk yield /animal (l/60days)	Cost of feeding (Rs./ animal)	Gross returns (Rs./ animal)	Net returns (Rs./ animal)	B:C ratio
Villupuram	Farmers practice	7.5	450	4050	4950	900	1.2
	Urea treatment of paddy straw	7.7	459	4131	5737	1606	1.4

5.5. Azolla Production

Khammam

In order to improve the fat percentage in dairy animals, Azolla is given as a supplementary feed along with farmer practice at Khammam district covering 10 farmers. The results indicated, 36.7% increase in fat content with an additional net income of Rs.1200/- cattle/ month (Table 38).

Table 38: Demonstration of azolla as alternative feed to milch animals at Khammam

Treatments	Azolla yield (kg/month)	Before fat percentage (Dairy animals)	After fat percentage (Dairy animals)	Net income (Rs./ month)
Azolla as supplementary feed	4	6	8.2	1200/ cattle

Azolla pits in Nacharam village

Azolla feeding to Dairy animal

5.6. Backyard Poultry for nutritional needs and income generation

Agriculture being dependent on weather is prone to uncertainty and hence agriculture alone is unable to provide livelihood security to small and marginal farmers in rain fed regions. There is a need to supplement the income of the farmers from agriculture though income generating activities like backyard poultry for sustaining livelihood and to have assured income from at least one source.

Chittoor

Demonstrations on improved poultry breed Rajasri were conducted to supplement income of small and marginal farmers where 50 farm families were benefited. Rajasri breed was found superior to local breed with higher growth rate and additional net income of Rs. 370/year/ bird. The improved breed laid 60 more eggs /bird /year (Table 39).

Rajasri

West Godavari

Local poultry breeds have less growth rate, egg laying capacity and high susceptibility to diseases. So demonstrations on improved breed (Vanaraja) were conducted in NICRA village of West Godavari district. Improved breed performed better than local breed in terms of additional net returns (Rs.965/bird), body weight (0.5kg) and number of eggs (83/year) laid per year (Table 39).

Distribution of poultry birds to farmers

Nalgonda

In Nalgonda the improved breeds **(**Rajasri & Vanaraja) gave additional net income of Rs. 530/- bird by giving 100 eggs more per bird and putting on 0.8 kg higher body weight after one year compared to local breed (Table 39).

Distribution of improved poultry breeds to farmers

Ramanathapuram

The improved breed (Namakkal Desi) produced 200 eggs/bird compared to local breed (100) and gave additional net returns of Rs.180/bird compared to local breed (Table 39).

Table 39: Performance of poultry birds in augmenting farm income in NICRA Villages

KVK	Particulars	Initial wt.(g)	Weight of bird (Kg) after one year	No. of eggs/ year	Total expenditure (Rs./ year)	Income from eggs (Rs.)	Income from meat (Rs.)	Total income (Rs.)
Chittoor	Local Breed	150	2.2	220	540	880	250	1130
	Rajasri	150	2.5	280	360	1120	200	1320
West Godavari	Local Breed	450	1.5	52	660	260	500	760
	Improved Breed	450	2	135	1050	1215	900	2115
Nalgonda	Local Breed	300	2.2	60	450	300	550	850
	Improved Breed	450	3.0	160	620	800	750	1550
Ramanatha puram	Local breed	400	1.2	100	250	630	3750	4380
	Improved Breed (Namakkal Desi)	600	2.2	200	1000	1260	4050	5310

Khammam

Local poultry breeds have less growth rate, egg laying capacity and high susceptibility to diseases. Hence, demonstrations on improved breed, Rajasree were conducted in NICRA village of Khammam district. Rajasri breed performed better than local breed with higher body weight of 2000 gms at maturity (Table 40).

Table 40: Performance of poultry birds in augmenting farm income at Khammam

Particulars	Local chicks	Resilient chicks (Rajasri)
Weight (2 months) (gms)	350- 400	500
Mortality rate (%)	90	98
Egg laying stage	6 months	6 months
Egg weight in (gms)	45-50(40-60 per annum)	55 (160-170 per annum)
Weight in egg laying stage (gms)	1200	1750
Maturity stage (gms)	1300	2000

Distribution poultry chicks (One month old)

Thiruvarur

Poultry rearing is one of the important sources of additional income in NICRA village of Thiruvarur district. It is an unorganized sector as the rearing system does not follow any scientific methods and improved breeds. By inclusion of improved breed like TANUVAS Aseel in backyard poultry there is an increase in income up to 53% (Table 41).

Table 41: Performance of poultry birds in augmenting farm income at Thiruvarur

Treatments	Yield in kg/bird	Cost of production/ bird (Rs.)	Gross income (Rs./ bird)	Net income (Rs./ bird)	B:C ratio
Local species	0.69	118	276	158	2.3
TANUVAS Aseel	0.94	134	376	242	2.8

Villupuram

In the demonstrations at Villupuram, Tamil Nadu, the improved poultry breed, Nandanam-2 recorded higher body weight (0.3 kg) with an additional net income of Rs.4328/- bird compared to local breed (Table 42).

Table 42: Performance of poultry birds in augmenting farm income at Villupuram

Particulars	Weight of bird (Kg) 8th week	Total expenditure (Rs.)	Gross income (Rs.)	Net income (Rs.)	B:C ratio
Local Breed	0.78	2800	6372	3572	2.3
Nandanam-2	1.08	3900	11800	7900	3.0

Nandanam-2

5.7. Conservation of cattle

Calf registration and healthy calf programme at Kurnool

Dairy farming is the most sustainable livelihood to the farmers. Continuous growth in dairy sector in Kurnool district indicates the interest of the farmers towards this sector. Scientific rearing of dairy animals will keep the animals healthy as well as productive. Especially, calves are usually neglected and are not provided proper medication and feeding. This results in poor growth rate and delayed maturity (4-5years). To educate the farmers on scientific practices in calf rearing "Calf registration and healthy calf programme" was initiated during 2011-12 under NICRA project in Yagantipalle village with an objective to reduce the calf mortality and to improve growth rate in calves.

Methodology:

Initially two villages *viz.,* Cherlokotturu and Krishnagiri of Banaganapalle mandal were selected for the study. Training programme was organized to create awareness about the programme. The steps in calf registration include,

- The farmer has to register his calf immediately after birth
- Technical staff of KVK visits the calf and cuts the umbilical card and record the body weight. He will closely monitor calf in feeding of colostrums.
- A calf health card will be issued to the farmers for filling the initial data about the calf.
- Calf health card contains details about medication, feeding and growth particulars of the registered calf.
- Every month a health camp will be conducted to treat the registered calves in both the villages.
- De-worming, supplementation of Vit. A and B-Complex was done to the calves. Body weight was recorded in the health card.
- From the second month onwards, calf starter was provided to feed the calves along with milk to make balanced diet.
- To mitigate the mineral deficiency, salt bricks were also given to the registered calves.

In this programme, the registered calves were provided scientific feeding and medication up to six months age. During 2018-19, 50 buffalo calves were registered under the programme in NICRA villages. The registered calves showed 21.17% increase in body weight gain with reduced mortality rate (6%) over un- registered calves (14%) (Table 43).

Table 43: Performance of calves registered under calf registration programme

Particulars	Farmers practice	Demonstration	Remarks
Initial body weight (kg)	23.4	24.3	**The increased growth rate helps the calf to come into heat early.**
Final body weight (kg)	62.6	71.6	
Body weight gain (kg)	39.2	47.6	
% increase in body weight gain	21.17		
Mortality (number)	7	3	
Mortality (%)	14	6	

Animal health camp

Namakkal

In order to enhance the availability of veterinary health care at the doorstep of farmers at Namakkal, community health care services were provided to 1947 poultry birds and 482 sheep and 535 goat covering 247 farmers during 2018-19. Deworming and regular vaccination of livestock (small ruminants) showed an increased body weight (16 kg/6months) over the control (12 kg) with an additional net returns of Rs.950/- animal (Table 44).

Table 44: Performance of regular vaccination in small Ruminants

Particulars	Farmers practice	Treated
Initial body weight (kg)	1.5 to 1.75	1.75 to 2
Final body weight (kg) 6 month	12	16
Total Gross returns (Rs.)	3600	4800
Total cost (Rs.)	1850	2100
Net returns (Rs.)	1750	2700
BCR	1.94	2.28

Vaccination of livestock at Namakkal

5.8. Shelter Management for stress tolerance to livestock

Villupuram

In NICRA adopted village most of the farmers are small holders and they do not have proper housing for their poultry birds. In these conditions, the birds are subject to heat stress, prone to vector borne diseases and the production performance of the birds remains low which leads to low survival rate and high mortality percentage of chicks. Protective cage system was introduced to improve the survival percentage of birds which in turn increases the economic condition of the farmers. The birds under improved house showed better performance over the control in case of mortality and net returns (Table 45).

Table 45: Performance of poultry birds in augmenting farm income

Particulars	Mortality in chicks (%)	Total expenditure (Rs.)	Gross Income (Rs.)	Net income (Rs.)	B:C ratio
Conventional	22.5	2800	4860	2060	1.7
Cage system	0	8000	19800	11800	2.5

Ramanathapuram

Demonstrations on improved shelters for poultry birds were demonstrated for 5 farm families benefiting 50 birds at NICRA village of Ramanathapuram district. The birds under improved shelters earned an additional net income of Rs.32250/- compared to farmer practice (Table 46).

Table 46: Performance of improved shelters in augmenting farm income

Particulars	Initial wt.(g)	Weight of bird (kg) after one year	No. of eggs/year	Total expenditure (Rs.)	Income from eggs (Rs.)	Income from meat (Rs.)	Total income (Rs.)
Local method	400	1.50	90 - 110	16250	31500	22500	54000
Improved shelters	600	3.00	180 -220	20000	63000	27000	90000

Khammam

At NICRA village of Khammam district, cattle are facing mosquito problems from rainy to winter season. To avoid this problem, KVK distributed mosquito cloth nets to 10 farm families. Livestock under mosquito net showed additional milk yield of 57-75 lt/60 days compared to farmer practice.

Cattle shed covered with mosquito cloth net

5.9. Promotion of Fisheries

Srikakulam

Captive rearing of fish seed

Captive rearing of fish seed *i.e.,* rearing of fish fry up to fingerling stage in nursery pond was demonstrated at Srikakulam to reduce the loss of mortality during acclimatization. Captive rearing not only increases the percentage of survival but also reduces the cost of seed when purchased directly from the market. Rearing fish seed in pen culture (Hapa nets) at grow out culture ponds from spawn stage to advance fry stage showed 32.5% of survival rate and BC ratio 1.6 compared to farmers practice. Farmers could save upto Rs.11220/- for the same number of fish seedlings through captive rearing (Table 47).

Table 47: Captive rearing of fish at NICRA village of Srikakulam

Treatments	Fish seed Survival (no/unit)	Cost of cultivation (Rs/per unit)	Gross income (Rs/unit)	Net income (Rs/ha)	B:C ratio	Quantity used for livestock and qty. sold
Captive Rearing of fish seed up to fingerling size in nursery ponds	46800 no.s advance fry realized *i.e* 32.5%	17750 (@ 0.37 rupees for fingerling)	28970	11220	1.6	46800
Purchase from outside market	46800	28970 (@ 0.50 rupees for fingerling) if purchased out side	--	--	--	--

Captive rearing of fish seed at Srikakulam

West Godavari

Water quality management in fish ponds

Water quality management in fish ponds was taken up to avoid sudden mortality due to changes in water quality parameters. Monitoring of water quality *viz.,* Dissolved oxygen (DO), ammonia content and pH in fish ponds and adoption of correction measures on need basis resulted in 10.9% increase in yield and gave an additional income of Rs 18500/ha (Table 48).

Table 48: Water quality management in fish ponds at West Godavari

Treatments	Yield (Kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	BC ratio
Farmer practice	4600	297000	368000	71000	1.2
Intervention covered pond	5100	318500	408000	89500	1.3

Training on water quality management

Water quality testing in fish pond

Evaluation of Probiotic (CIBA^{SP}) for water quality management in shrimp culture ponds

Poor water and soil quality causing stress and disease incidence in shrimp culture ponds at NICRA village of West Godavari district. In order to maintain good quality water in shrimp ponds, demonstrations on use of probiotics were taken in an area of 10 ha covering 5 farmers to avoid stress, disease incidence and sudden mortality of shrimps. The treated pond recorded 55.55% improved yield with an additional net income of Rs.408222/ha with favourable BC ratio of 2.2 over the farmers practice (Table 49).

Table 49: Effect of probiotics on production and productivity of shrimp at West Godavari

Treatments	Yield (Kg/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	B:C ratio
Farmer practice	4500	908222	1125000	216778	1.2
Treated pond	7000	800000	1750000	625000	2.2

Application of probiotic in shrimp pond

Polyculture of L. Vannamei with Indian major carps against monoculture of fish

In order to maintain good stocking density, better disease management, extra net income and total utilization of different trophic and spatial niches of a pond and to obtain maximum fish- shrimp production per unit area, polyculture of fish and shrimp was demonstrated in an area of 10 ha covering 5 farmers at West Godavari district. Poly culture plots recorded Rs.53,000/- additional income per hectare compared to control (Table 50).

Table 50: Performance of polyculture of L. Vannamei with Indian Major Carps

Treatments	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	B:C ratio
Farmer practice	4100	255800	328000	72000	1.3
Intervention covered pond	4000+ 1000	300000	300000+ 125000	125000	1.4

Polyculture (fish+ shrimp) pond

Thiruvarur

Composite fish culture

To utilize the source of feed in different layers of the pond, KVK demonstrated Composite fish culture (Rohu, Mrigal, Silver carp, common carp and Catla) over the open pond rearing with local species (Tilapia) in an area of 0.1 ha covering 5 farmers at Thiruvarur district. Composite culture pond showed 35.24% increase in yield with an additional net income of Rs 6923/unit compared to farmer practice (Table 51).

Table 51: Production and economics of rearing fish in farm pond

Treatments	Yield in kg/ unit size of pond	Cost of production/unit size of pond (Rs.)	Gross income (Rs./unit)	Net income (Rs./unit)	B:C ratio
Farmer practice	122	9531	12200	2669	1.3
Composite fish pond	165	13508	23100	9592	1.7

Fish fingerlings releasing into pond

Composite fish culture

6. Institutional Interventions

6.1. Custom hiring center

Increasing scarcity of human labour and difficulties associated with upkeep of animals has necessitated a shift in Indian agriculture from dependence on human and animal power to mechanical power. Mechanical power enables timeliness of farm operations besides reducing drudgery and thus contributes to increased productivity directly. Because of the capital involved in acquiring machines/tools used in agriculture, the use of them is largely confined to big land holdings and is still beyond the reach of small/marginal holdings which constitute around 80% of the total land holdings. This is due to the fact that small/marginal farmers, by virtue of their economic condition are unable to own farm machinery on their own or through institutional credit. With the objective of making farm machinery available to small and marginal farmers, Custom Hiring Centers (CHC) with collective ownership have been included as one of the institutional interventions under NICRA.

Custom Hiring Center (CHC) houses a combination of farm machinery, implements and equipment that can be hired on cost basis by farmers of the NICRA village. Though certain implements and equipment are crop specific, the traction units like tractors, power tillers and self-propelled machinery like combined harvesters etc., are used commonly in all crops. It was ensured that the CHC has farm machinery that are commonly used for tillage operations for all crops, multi crop equipment and a minimum of crop specific machinery. The center is maintained by the Village Climate Risk Management Committee (VCRMC). A separate bank account is maintained to deposit the hiring charges collected, a part of which is used for the repairs of the tools and implements.

Objectives:

- To make available various farm machinery/equipment to small and marginal farmers
- To offset the adverse economies of scale due to high cost of individual ownership
- To improve mechanization in places with low farm power availability
- To provide hiring services for various agricultural machinery/implements applied for different operations.
- To expand mechanized activities during cropping seasons in large areas especially in small and marginal holdings.
- To provide hiring services for various high value crop specific machines applied for different operations.

Progress of CHCs in NICRA centers

Andhra Pradesh

Anantapur

Groundnut is an important oilseed crop grown in NICRA village of Anantapur district under rainfed conditions. Timeliness, precision in sowing and other crop production operations largely decide the productivity of this crop. Farmers are forced to sow the crop even up to the end of August due to non- availability of labour and draft power. Custom Hiring Center was established in the NICRA village during 2011 for providing timely services for various agricultural operations to the farmers. Timely sowing of groundnut, greengram, korra and jowar with automatic seed drill, threshing of groundnut with thresher and sub-soiling for *in-situ* moisture conservation were the farm operations that could be undertaken by farmers in the NICRA village during 2017-18 through hiring of farm implements of the CHC. The center provided hiring services to 95 farmers covering 200 ha and earned net income of Rs. 37400/- (Table 52).

Chittoor

Custom Hiring Centre was established during 2015-16. The equipment available in the center are sub-soiler, disc plough, tarpaulins, drum seeders, power weeder, taiwan sprayers, power sprayers, knapsack sprayers, brush cutter, pole pruner, tractor mounted sprayer, star weeders, sprinkler system, mini rice mill, secateurs, loppers and pruning saws. During 2018-19, the custom hiring services were mainly utilized in the crops *viz.,* paddy, tomato, groundnut and mango on an area of 19 ha benefitting 40 farmers and earned net income of Rs.5600/- (Table 52).

Kurnool

Custom Hiring Center was established in the NICRA village in 2011 with an investment of Rs.6.25/- lakh as a group activity. During 2018-19, the custom hiring center provided hiring services for various operations in crops like pigeonpea, jowar, chickpea and foxtail millet in an area of 38 ha covering 17 farmers and realized an income of Rs.4200/- (Table 52).

Srikakulam

The custom Hiring Centre was established in NICRA village of Srikakulam district to provide community based hiring services with agricultural implements for timely agricultural operations during 2012-13. About 60 families became the members of the center. The

management committee was formed in the village to guide the operations of the center on 20th November 2011. The project supported the center with an investment of 6.25 lakhs. The committee assessed the needs of mechanization for different crops before finalizing action plan in each year.

In 2018-19, the center provided hiring services to the crops of paddy (15 ha), cotton (2.5 ha) and vegetables (2 ha) in an area of 19.5 ha covering 40 farmers with a net income of Rs.3250/- (Table 52).

West Godavari

The custom hiring centre was established in NICRA village of Undi in West Godavari district in the year 2011 with an investment of Rs.482077/-. In 2018-19, the center provided hiring services for an area of 7 ha covering 5 farmers and collected rental charges of Rs. 2500/- (Table 52).

Telangana

Khammam

The CHC was established in Nacharam village (NICRA village) of Khammam district during 2010-11 with an investment of Rs.55047/- for providing hiring services for different agricultural operations to the farmers. About 9 persons of VCRMC are engaged in running the center. In the process of operation, different commodity groups are formed to identify and assess the demand of tools for various crops and various operations and to prepare the schedule to be implemented during the year. The center procured taiwan sprayer (1), seed cum- fertilizer drill (1), paddy reaper (1), multi-crop thresher (1) and 2-M.B. plough (1). During 2018-19, the center provided hiring services an area of 29 ha covering 43 farmers and collected rental charges of Rs.19500/- (Table 52).

Nalgonda

The CHC was established in Nandyalagudem in Atmakur mandal of Nalgonda district during 2011-12. About 6.71 lakh rupees were invested in establishment of the center. The amount taken as loan from the bank for support of the center was Rs.44000/-. About 12 members of VCRMC are engaged to run this center and 155 farmers are the members. During 2018-19, the center provided hiring services to the crops of cotton (13.2 ha), paddy (4.8 ha) and mulberry (4.2 ha) in kharif season and cotton (3.4 ha), paddy (1.6 ha) and mulberry (2.0 ha) in rabi season covering a total of 56 farmers with an net income of Rs. 9525/- (Table 52).

Tamil Nadu

Namakkal

During 2018-19, the center provided hiring services to the crops of groundnut, sorghum and blackgram in kharif season and small onion in rabi season covering an area of 65 ha benefitting of 96 farmers with a net income of Rs. 25372/- (Table 52).

The equipment procured for the operation of the center is as follows

Rotovator	Chain block
Spring tyne cultivator\	Chain pully
Seed driller	Electronic weighing balance (50 g & 100 kg capacity)
Bund former	Electronic weighing balance (500 kg capacity)
Ridge former	Chisel plough
Community incubator	Liquid nitrogen container (35l & 3l capacity)
Mobile sprinkler	Mobile sprinkler accessories
Five tyne arrow cultivator	Spring loaded nine Tyne cultivator
Tractor attached tanker	Tractor attached sorghum harvester

Custom hiring center at Namakkal

Ramanathapuram

The CHC was established in NICRA village of Ramanathapuram district in the year 2011-12 under non-recurring contingencies for purchasing of agricultural implements. The CHC procured chisel plough, seed drill, disc plough, disc plough reversible type, power weeder, power sprayer, mini portable sprinkler, improved broad bed former cum seeder, paddy

daincha seeder, fertilizer cum seed drill, chilli seed extractor, chilli seed drill, chaff cutter and ridger seeder. During 2018-19, the center provided hiring services in an area of 25 ha covering crops like paddy (20 ha) and chilli (5 ha) benefitting 42 farmers and collected an amount of Rs.7200/year as service charges (Table 52).

Custom hiring center at Ramanathapuram

Thiruvarur

The CHC in the NICRA village of Thiruvarur provided hiring services on an area of 110 ha covering 92 farmers and earned net profit of Rs.175271/- during 2018-19 (Table 52).

Implements purchased during 2018 -19

Sl. No.	Implements purchased	Total cost (Rs.)
1.	Battery Sprayer (2 nos)	19600
2.	Electric blower (1 no)	9800
3.	Chain saw (1 no)	9900
4.	Bag closer sewing machine (1 no)	7500
	Total	**46800**

Villupuram

During 2018-19, the center provided hiring services to the crops of crossandra (0.2 ha) in kharif season and groundnut (7.8 ha) in rabi season covering 14 farmers and collected an amount of Rs.3000/- year as service charges (Table 52).

Table 52: Performance of custom hiring center at different NICRA centers during 2018-19

KVK	Farmers covered	Area covered (ha)	Revenue generated through CHCs (Rs.)
Ananthapur	95	200	37400
Chittoor	40	19	5600
Kurnool	17	38	4200
Srikakulam	40	19.5	3250
West Godavari	5	7	2500
Khammam	43	29	19500
Nalgonda	56	29.2	9525
Namakkal	96	65	25372
Ramanathapuram	42	25	7200
Thiruvarur	92	110	175271
Villupuram	14	8	3000

6.2. Seed bank

Productivity of any crop mainly depends on the quality of seed used by farmers. It is imperative to make available quality seed at right time and affordable prices to sustain the productivity of crops and in turn livelihood security of small and marginal farmers. The baseline studies in the project areas of NICRA identified key problems related to seed supply system. Lack of timely availability of good quality seed of high-yielding varieties is one of the major constraints contributing to stagnant yields of crops in the project area.

To address this problem alternative seed systems, which ensure availability of quality seed of improved varieties at local level have been developed under NICRA. The concept of village seed banks was promoted and successfully validated in the project villages. It not only ensured timely availability of quality seed of farmer-preferred varieties at affordable prices at local level but also enhanced crop productivity and ensured higher incomes to the farmers who took up seed production as a local enterprise.

Andhra Pradesh

Kurnool

Seed production in redgram var. Asha (1.5 tonne), redgram var. PRG-176 (2 tonnes), foxtail millet var. SIA-3088 (1.0 tonne), foxtail millet var.SIA-3221 (1.0 tonne) and Bengalgram var NBeG-3 (2.0 tonnes) was taken up for seed bank in the NICRA village of Kurnool district covering 17 farmers in 9.5 ha area (Table 53).

Telangana

Khammam

Seed production of paddy var. Siddi (28 tonnes) which is a salinity tolerant variety, was taken up for seed bank in NICRA village of Khammam district covering 93 farmers in 18 ha area. Sunhemp seed production (27 tonnes) was also taken in an area of 12 ha covering 270 farmers (Table 53).

Tamil Nadu

Villupuram

Seed production of ground nut variety, VRI 8 (0.8 tonnes) was taken up for seed bank in NICRA village of Villupuram district in an area of 0.4 ha covering 2 farmers (Table 53).

Table 53: Performance of Seed Banks at different NICRA centers during 2018-19

KVK	Name of crops	Quantity (t)	No. of farmers	Area (ha)
Andhra Pradesh				
Kurnool	Redgram (Asha)	1.5	5	2
	Redgram (PRG-176)	2	5	3
	Seteria (SIA-3088)	1	3	1
	Seteria (SIA-3221)	1	2	1
	Bengalgram (NBeG-3)	2	2	2.5
	Sub total	**7.5**	**17**	**9.5**
Telangana				
Khammam	Paddy (Siddi- WGL- 44)	28	93	18
	Sunhemp seed	27	270	12
	Sub total	**55**	**363**	**30**
Tamil Nadu				
Villupuram	Groundnut (VRI 8)	0.8	2	0.4
	Sub total	**0.8**	**2**	**0.4**
	Zone total	**63.3**	**382**	**39.9**

Seed bank at Khammam

6.3. Fodder bank

Fodder bank was established in NICRA villages, to mitigate the problem of fodder scarcity to livestock especially in delayed crop planting situation due to rainfall scarcity or drought conditions. The fodder varieties under fodder bank are highly nutritious and enabled farmers to have round the year the production of green fodder and increased their income from livestock, thereby reducing their vulnerability to climate risks.

Andhra Pradesh

10 tonnes of Hybrid Napier (Co-4) were produced in an area of 0.2 ha covering 2 farmers at Chittoor district in a fodder bank during 2018-19. Co-4 was cultivated in 2 ha area covering 15 farmers in NICRA village of Kurnool (Table 54).

Telangana

Under fodder bank, CoFS-29 was cultivated in an area of 34.4 ha benefitting 51 farmers by producing 1.4 tonnes at NICRA village of khammam district (Table 54).

Tamil Nadu

CoFS-29 was cultivated in an area of 7 ha at NICRA village of Ramanathapuram covering 10 farmers by producing 200 tonnes of fodder grass (Table 54).

Table 54: Performance of Fodder Banks at different NICRA centers during 2018-19

KVK	Fodder variety	No. of farmers	Area (ha.)	Quantity produced (t)
Chittoor	Hybrid Napier (Co-4)	2	0.2	10
Kurnool	Co-4	15	2	--
Khammam	CoFS-29	51	34.4	1.4
Ramanathapuram	CoFS-29	10	7	200

Fodder bank at Kurnool

Fodder bank at Ramanathapuram

Fodder bank at Khammam

7. Capacity building of farmers and youth on climate resilient practices/technologies

Capacity building of farmers in NICRA villages was taken up by KVKs through a series of knowledge and skill development training programmes conducted on varied thematic areas related to demonstrations of resilient technologies. This kind of training will enable the farmers to extend their support in recording need based data on technologies in respect of raising crops and livestock, NRM activities and crop production in different districts of Andhra Pradesh, Telangana and Tamil Nadu. The NICRA centers working in the state of Andhra Pradesh organized 103 skill oriented training programmers with the active participation of 3031 participants, while the NICRA centers in the state of Telangana organized 22 need based training programmes on improving the productivity of agricultural and horticultural crops, livestock, and custom hiring centers with active involvement of 633 participants. In Tamil Nadu, the NICRA centers organized 31 training programmes with the participation of 1009 farmers. Thus the principal investigators of NICRA in the states of Andhra Pradesh, Telangana and Tamil Nadu organized 156 training programmes with the participation of 3740 farmers and 926 farm women. The list of training programmes organized includes: Natural resource management, resource conservation technologies, soil productivity improvement, climate resilient intercropping systems, contingency crop planning, crop diversification, nutrient management, integrated pest management, soil test based fertilizer application, farm implements, fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock management etc. (Table 55 & 56).

Table 55: State-wise summary of capacity building activities

State	No. of courses	Male	Female	Total
Andhra Pradesh	103	2510	516	3031
Telangana	22	430	201	633
Tamil Nadu	31	800	209	1009
Grand Total	**156**	**3740**	**926**	**4673**

Table 56: Capacity building activities during 2018-19

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
Anantapur	Natural resource management	4	89	65	154
	Resource conservation technologies	2	95	51	141
	Crop diversification	1	36	29	75
	Crop management	6	167	52	219
	Nutrient management	4	114	21	135
	Pest and disease management	1	43	4	47
	Livestock management	3	87	21	108
	Fodder and feed management	1	23	12	35
	Total	**22**	**654**	**255**	**914**
Chittoor	Production technology of fodder sorghum	1	56	2	58
	In-situ soil moisture conservation technologies	1	41	10	51
	Awareness programme on NICRA activities	1	30	2	32
	Importance of sub soiler in rainfed agriculture	1	22	2	24
	Production technology of groundnut	1	24	1	25
	Importance of green manuring in rainfed mango	1	50	0	50
	Production technology of Tomato	1	20	0	20
	Backyard poultry	1	50	3	53
	Integrated pest management in tomato	1	31	0	31
	Intercropping system in dryland agriculture	1	27	0	27
	Production technology of Chrysanthemum	1	30	0	30
	Production technology of fodder Hybrid Napier co-4	1	25	0	25
	Production technology of Horse gram	1	20	0	20
	Mushroom production technology	1	21	5	26
	Integrated nutrient management in Mango	1	30	2	32
	Production technology of pole bean	1	21	0	21
	Integrated crop management in mango	1	51	9	60
	Total	**19**	**549**	**36**	**585**

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
Kurnool	Production technologies for rainfed crops	1	36	4	40
	Feed & fodder technologies for livestock	1	36	4	40
	Soil & Water conservation technologies for rainfed areas	1	31	4	35
	Farm implements & machineries	1	28	4	32
	Contingent crop planning & management	1	36	2	38
	Soil & Water conservation technologies for rainfed areas	1	32	3	35
	Feed & fodder technologies for livestock	1	25	3	28
	Prevention of disease in livestock	1	21	8	29
	Rabi crop preparedness programme	1	34	5	39
	Importance of home stead nutritional gardens	1	24	21	45
	Soil health management	1	29	6	35
	Importance of home stead nutritional gardens	1	8	42	50
	Production technologies for rainfed crops	1	32	8	40
	Contingent crop planning & management	1	28	4	32
	Crop pest disease management	1	32	6	38
	Pest management in chillies	1	22	4	26
	Value addition to millets	1	6	34	40
	Bengalgram & redgram management practices	1	26	6	32
	Crop pest disease management in redgram & Bengalgram	1	30	5	35
	Management practices in live stock & Mango	1	25	3	28
	Post harvesting technology	1	38	4	42
	VCRMC meeting and discussions on demonstrations	1	18	2	20

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
	Zonal Review meeting	1	46	4	50
	Interface meeting for NICRA and non NICRA farmers	1	42	8	50
	Interaction with NICRA and Other village farmers	1	44	6	50
	Total	**25**	**726**	**203**	**929**
Srikakulam	Integrated nutrient management in paddy	1	24	3	27
	Kharif Pest and Disease management	1	21	2	23
	Resource conservation technology on zero tillage maize	1	9	--	9
	Water management in zero tillage maize	1	24	10	34
	Fall army warm management in maize crop	1	24	7	31
	Total	**5**	**102**	**22**	**124**
West Godavari	Paddy nursery management	2	30	-	30
	Bio fertilizers application in paddy	2	45	--	45
	Azolla production	2	30	--	30
	Water quality management fish ponds	2	20	--	20
	Disease diagnosis in prawn ponds	2	20	--	20
	Rodent management in paddy	2	50	--	50
	Pest and disease management in paddy	2	40	--	40
	Black headed caterpillar in coconut	2	42	--	42
	BPH and diseases management in paddy	2	26	--	26
	Training programme on mechanical transplanted paddy	2	22		22
	Training programme on direct sowing & machine transplanting in rabi paddy	2	30		30
	Training Programme on weed & irrigation management in paddy	2	25		25
	Machine transplanting in Paddy	2	19		19
	Direct sowing with drum seeder in Paddy	2	30		30

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
	Nursery management in mechanical transplanting	2	30		30
	Training programme on pulse production technology	2	20		20
	Total	**32**	**479**	**0**	**479**
Khammam	Farm mechanization and importance of custom hiring centre.	2	41	13	54
	In-situ moisture conservation practice in rain fed crops.	2	46	16	64
	Drought and mitigation practices in kharif crops.	2	45	15	60
	Pest and disease management in kharif crops.	2	48	14	62
	Climate change related diseases and their control in live stock	2	52	12	64
	Total	**10**	**232**	**70**	**304**
Nalgonda	Recycling of crop residue	1	16	-	16
	Livestock management (Backyard poultry)	1	17	31	48
	Soil sample collection and importance of soil testing	1	7	14	21
	Pre-seasonal training on double the income of the farmer	1	21	23	44
	Soil health management	1	22	2	24
	Resource conservation technology	1	19	7	26
	Foliar nutrient management	1	15	7	22
	Soil health management	1	21	-	21
	Crop diversification	1	21	18	39
	Training programme on vegetable cultivation	1	16	19	35
	Fodder and feed management	1	14	6	20
	Vegetable planting with easy planter	1	9	4	13
	Total	**12**	**198**	**131**	**329**

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
Namakkal	Off campus training cum demonstration on nursery management small onion var. CO-5 distribution of seed and *Trichoderma viride* in convergence mode with NHRDF, Coimbatore	2	25	3	28
	Training programme on importance of soil and water testing	1	24	3	27
	Field day on small onion CO-5	1	17	3	20
	Field day on Groundnut var. TCGS-1078	1	38	11	49
	Total	**5**	**104**	**20**	**124**
Ramanatha-puram	Soil sampling techniques and management of problem soils	1	14	16	30
	Seed treatments and seed hardening techniques in semi dry rice	1	19	13	32
	Seed drill sowing and its advantages in semi dry rice cultivation	1	12	10	22
	Improved Production technology of chillies	1	13	8	21
	Foliar application of PPFM for drought mitigation	1	14	8	22
	Micronutrient deficiencies and their management in rainfed paddy cultivation and use of biofertilizers	1	16	7	23
	IPM strategies in semi dry rice	1	15	5	20
	Azolla production technology and CO (FS) 29 cultivation techniques	1	10	16	26
	Animal health management	1	6	16	22
	Improved method of poultry rearing	1	30	16	46
	Total	**10**	**149**	**115**	**264**
Thiruvarur	ICM in flood tolerant paddy variety – CR 1009 sub 1	1	42	10	52
	Importance of soil testing	1	32	5	37
	ICM in flood tolerant paddy variety - Swarna Sub1	1	64	24	88
	IPDM in paddy	1	22	5	27

KVK	Title of the training Programme	No. of courses	No. of participants		
			Male	Female	Total
	Integrated Farming system	1	19	2	21
	Vermicompost production technology	1	28	4	32
	ICM in black gram (ADT 5)	1	30	9	39
	Composite fish culture	1	13	2	15
	Total	**8**	**250**	**61**	**311**
Villupuram	Integrated pest and disease management in Pulses	1	30	6	36
	Mushroom cultivation	1	15	2	17
	Compost making	2	45	2	47
	Fodder cultivation and preservation techniques	1	18	3	21
	On campus training on IPDM in paddy	1	75	-	75
	On campus training on IPDM in oilseeds	1	92	-	92
	Soil and water management techniques	1	22	-	22
	Total	**8**	**297**	**13**	**310**

Training programme (Anantapur)

Training programme (Srikakulam)

Training programme (West Godavari)

Group discussion (Khammam)

VCRMC meeting (Nalgonda)

Training programme (Namakkal)

Training programme (Villupuram)

8. Extension activities for popularization of climate smart agricultural practices

Various extension activities were taken up by KVKs in NICRA villages in order to bring awareness among farmers on climate resilient agricultural technologies and to motivate them for wider adoption of the same. The extension activities organized by different KVKs in NICRA centers during 2018-19 include awareness programmes on climate resilient agriculture, field days, kisan melas, method demonstrations, health camps, diagnostic visits, agro-advisory services, exposure visits etc. A total of 317 extension activities were taken up with the participation of 13612 farmers. Among these, 188 activities were organized with 7050 farm men and 3268 farm women in the state of Andhra Pradesh: while in Telangana state, 69 extension activities were organized with the participation of 1782 farm men and women. About 1549 farm women and men participated in 60 extension activities in the state of Tamil Nadu during 2018-19. The details are presented in Table 57 and 58.

Table 57: State wise summary of extension activities

State	No. of programmes	No. of participants		
		Male	Female	Total
Andhra Pradesh	188	7050	3268	10281
Telangana	69	1244	538	1782
Tamil Nadu	60	1116	433	1549
Grand Total	**317**	**9410**	**4239**	**13612**

Table 58: Extension activities conducted at different NICRA centers

KVK	Title of the activity	No. of activities	No. of participants		
			Male	Female	Total
Anantapur	Method demonstrations	4	79	8	87
	Agro advisory services	20	160	30	190
	Awareness	2	70	40	110
	Exposure visits	5	139	21	160
	Field Day	2	15	26	41
	Group discussion	8	174	36	210
	Diagnostic visit	5	52	9	61
	Total	**46**	**689**	**170**	**859**

KVK	Title of the activity	No. of activities	No. of participants		
			Male	Female	Total
Chittoor	Method demonstrations	5	115	25	140
	Awareness	4	220	30	250
	Field Day	6	137	18	155
	Group discussion	6	70	15	46
	Diagnostic visit	24	181	8	189
	Total	**45**	**723**	**96**	**780**
Kurnool	Stem application in Bt-cotton, Seed treatment of jowar and Bengalgram.	3	93	13	106
	VCRMC and NICRA farmers interface meeting	3	82	14	96
	Kisan Diwas	1	64	0	64
	Awareness in production technologies on rain fed crops	1	31	8	39
	ARS, Anantapur	1	12	0	12
	Agro advisory services	52	4940	2912	7852
	Interaction with NICRA & other village farmers	1	48	6	54
	Total	**62**	**5270**	**2953**	**8223**
Srikakulam	Method demonstrations on zero tillage maize	5	12	20	32
	Agro advisory services	13	20	5	25
	Diagnostic visit	3	42	4	46
	Exposure visits	2	20	0	20
	Group discussions	4	24	8	32
	Field day	1	28	12	40
	Total	**25**	**144**	**49**	**195**
West Godavari	Method demonstration on testing of dissolved oxygen in ponds	1	18	-	18
	Method demonstration on seed treatment in paddy	1	15	-	15

KVK	Title of the activity	No. of activities	No. of participants		
			Male	Female	Total
	Method demonstration on application of bio-fertilizers in paddy	1	22	-	22
	Group discussion on water quality management in fish ponds	1	26	-	26
	Method demonstration on disease diagnosis in prawn ponds	1	20	-	20
	Method demonstration on taking water quality parameters in fish ponds	1	16	-	16
	Method demonstration identification of stem Rot in Paddy	1	22	-	22
	Group discussion on Bacterial Leaf Blight in Paddy	1	29	-	29
	Group discussion on Stem rot and BPH management in paddy	1	26	-	26
	Method demonstration on tray nursery preparation for mechanical transplanting in Paddy	1	30	-	30
	Total	**10**	**224**		**224**
Khammam	Method demonstrations	12	256	111	367
	Agro advisory services	15	350	110	460
	Awareness programmes	6	148	52	200
	Group discussions	8	94	56	150
	Diagnostic visit	7	140	58	198
	Field day	1	58	20	78
	Total	**49**	**1046**	**407**	**1453**
Nalgonda	Method demonstration	2	28	16	44
	Agro advisory services	5	790	361	1151
	Awareness programmes	2	23	8	31
	Group discussions	5	64	37	101

KVK	Title of the activity	No. of activities	No. of participants		
			Male	Female	Total
	Diagnostic field visits	5	33	9	42
	Field day	1	23	12	34
	Total	**20**	**198**	**131**	**329**
Namakkal	VCRMC Meeting	1	6	2	8
	Orientation programme on new NICRA village	1	26	5	31
	Demonstration and installation of rain guage in new NICRA village	1	19	1	20
	Exposure visit on Regional Research Station Thirupathi, Kadiri and RASS KVK	1	11	0	11
	Distribution of small onion Co(On)-5 under convergence mode at NHRDF	1	8	1	9
	Exposure visit on IIHR, Bengaluru and Tumkur, KVK	1	8	4	12
	Exposure visit to Mecheeri Sheep Research Station, Mecheeri, Salem	1	27	11	38
	Farmers Exposure visit to Krishimela @ Namakkal	3	61	26	87
	Soil health camp conducted with Department in NICRA village	1	16	13	29
	Total	**11**	**182**	**63**	**245**
Ramanatha puram	Exposure visit of farmers	1	19	12	31
	Strengthening SHGs	1	-	12	12
	Integrated farming system	2	15	10	25
	Field days	1	21	18	39
	Method demonstrations	4	25	20	45
	Awareness	2	14	26	40
	Others – Animal Health Camp	1	7	14	21
	Total	**12**	**101**	**112**	**213**

KVK	Title of the activity	No. of activities	No. of participants		
			Male	Female	Total
Thiruvarur	Method demonstration	1	42	10	52
	Method demonstration	1	32	5	37
	Method demonstration	1	64	24	88
	Method demonstration	3	5	10	15
	Method demonstration	2	28	4	32
	Method demonstration	1	28	5	33
	Diagnostic Field visit	6	64	10	74
	Meetings	10	14	-	140
	Field day	1	46	19	65
	Women awareness day	1	30	12	42
	Exposure visit	1	41	15	56
	Total	**28**	**380**	**114**	**494**
Villupuram	Exposure visit to attend Kisan Samriti Mela to explore new technologies & varieties, marketing of organic inputs	1	43	2	45
	Backyard poultry	1	22	4	26
	Black gram	1	22	3	25
	Release of egg parasitoid	1	15	-	15
	Mechanization in groundnut	1	12	-	12
	Created awareness on using domestic waste water for best utilization for kitchen garden establishment	1	15	15	30
	Eradication of Parthenium weed	1	32	-	32
	Method of soil sample collection	1	12	-	12
	Eradication of Parthenium weed	1	280	120	400
	Total	**9**	**453**	**144**	**597**

Method demonstration (Anantapur)

Field day (Chittoor)

Method demonstration (Khammam)

Method demonstration (Nalgonda)

Exposure visit (Thiruvarur)

Awareness Programme (Villupuram)

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